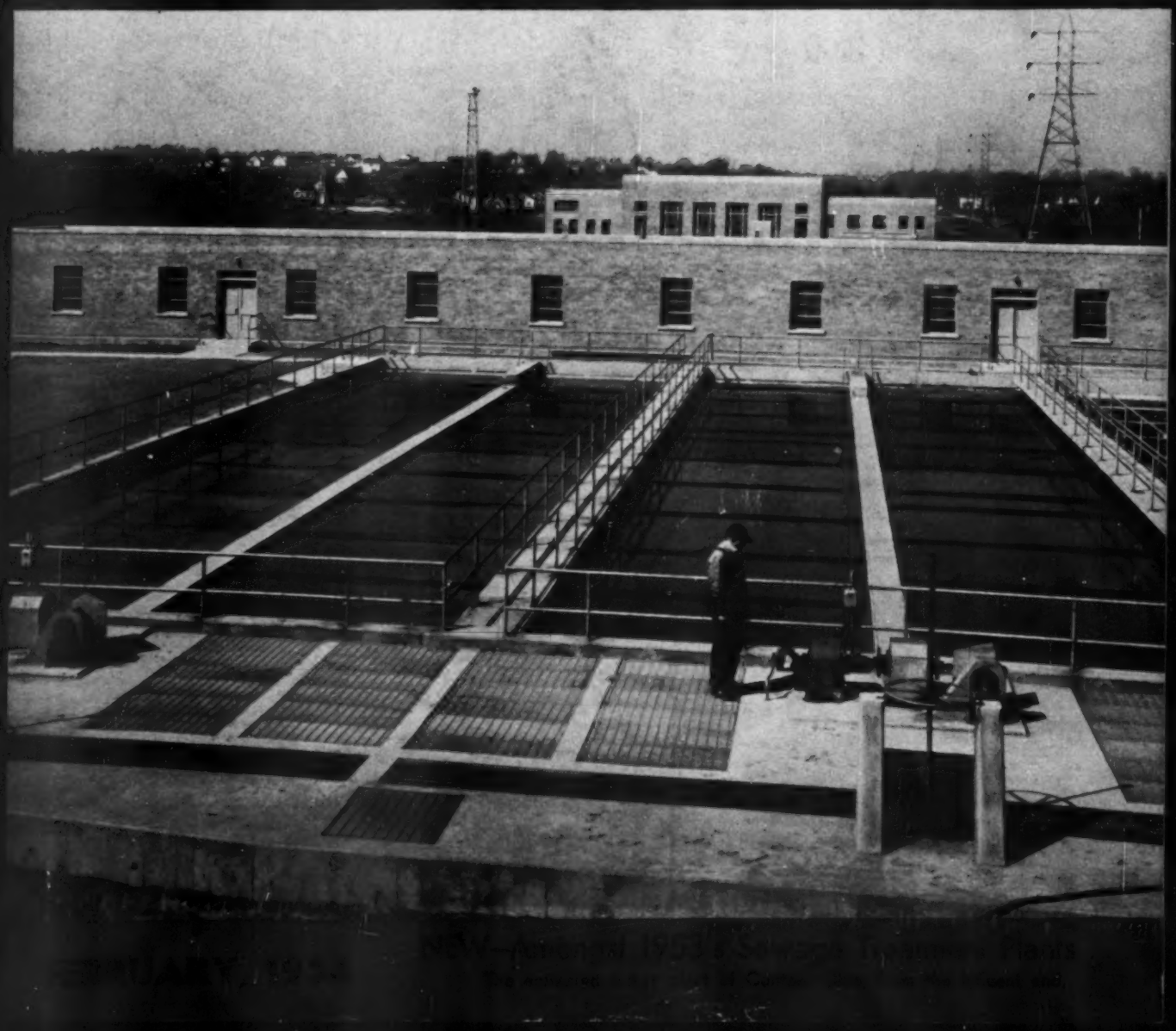
WATER & SEWAGE WORKS

WATER SUPPLY • INDUSTRIAL WASTE TREATMENT • SEWAGE DISPOSAL

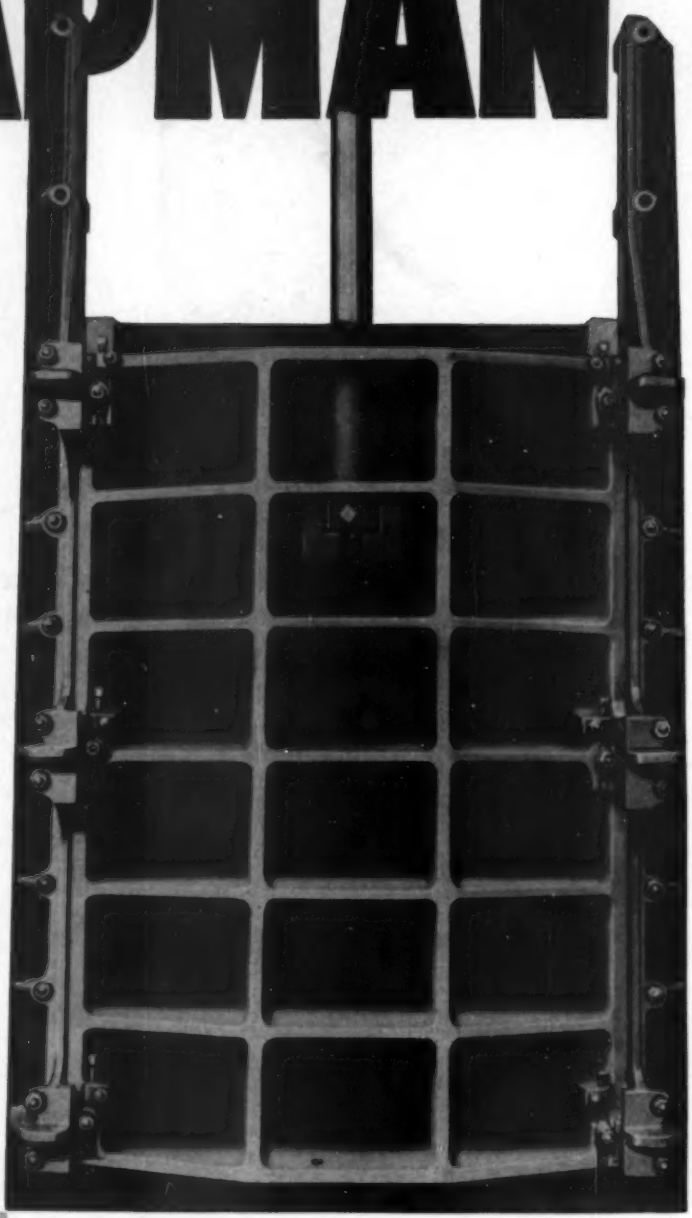


You "GIVE THE GATE" to Excessive Costs

...when you install

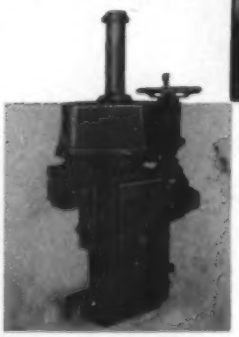
CHAPMAN

Standard SLUICE GATES



Here's why Chapman means top protection against excessive costs: First, Chapman's standard line of sluice gates includes many types and sizes that would be specials in anyone else's catalog. Next, installation is quick and easy because stems and couplings don't have to be match-marked. And any servicing or repairs can be done on the job, at minimum expense.

These 3 important savings tell you why Chapman Standard Sluice Gates rate first with well-managed waterworks, sewage works and flood control projects all over the country. Write for Catalog today.



. . . and here's still another saving: Chapman's Motor Unit comes to you complete . . . all you have to do is bring the power leads into the connection box . . . and there's your operating control, all ready to go to work.

The Chapman Valve Manufacturing Company

INDIAN ORCHARD, MASSACHUSETTS

WATER AND SEWAGE WORKS. Reg. U. S. Patent Off. Published monthly by Scranton Publishing Co., at 404 North Wesley Ave., Mount Morris, Ill. Entered as second class matter Mar. 4, 1948, at the post office at Mount Morris, Ill., under Act of March 3, 1879. For subscription rates, see Contents Page.

Newark, Ohio is no different from your city. You want the best pipe you can get for your water supply. So does Newark.

You want a line that meets every one of the "Big 3" requirements for an ideal water supply line: *long life, great strength* and *sustained high carrying capacity.* So does Newark.

That's why Newark picked Price Prestressed Pipe for its 16, 20 and 24 inch transmission and distribution lines . . . because Price Pipe gave them *all 3* of the "Big 3."

Miami, Louisville and Cleveland picked Price Pipe too . . . they wanted long life and protection from blow-ups, tuberculation and corrosion.

If *you* want this protection, put Price Concrete Pressure Pipe in your specifications.

Price Brothers Company

1802 East Monument Ave. • Dayton 1, Ohio

Concrete Pressure Pipe for Water Supply, Subaqueous, Pressure Sewer and Culvert Installations

Preventing high-volt leaks with PERMUTIT demineralized water

THE 75′ diameter atomic accelerator shown below has five times more power than any other. Its 2200 ton electromagnet quickly whips particles three million times 'round the racetrack to an energy approaching 3 billion electron volts.

Packing all this power into a reasonable-size unit was a problem. Size ruled out air cooling. So the bus-bar magnet coil was made for circulating cooling water.

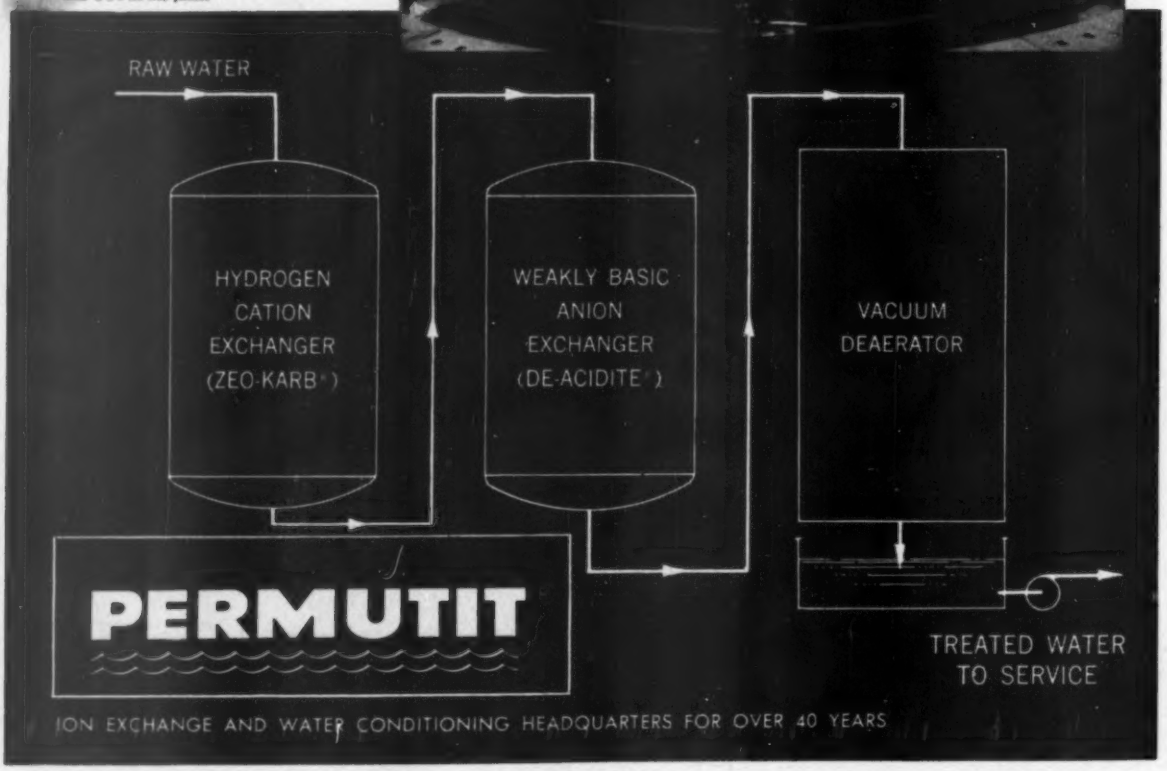
But at 3,000 volts, the dissolved minerals in *untreated* cooling water could conduct electricity, causing appreciable leakage to grounded piping. A means had to be found for producing water purer than conventional distilled water—at low cost.

A Permutit Demineralizer was selected *(see diagram)*. Cooling water recirculated through this ion exchange unit approaches the very low conductivity of pure water, hence it has been completely effective in removing dissolved solids.

Find out how Permutit can solve your water problems. Write to THE PERMUTIT COMPANY, Dept. W-2, 330 West 42nd Street, New York 36, N. Y., or Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

The giant Cosmotron at Brookhaven National Laboratory.

Permutit two-step Demineralizer with Vacuum Deaerator. Troublesome cation impurities are removed in the first step, remaining minerals in the second, oxygen and CO_2 in the final.


RAW WATER
HYDROGEN CATION EXCHANGER (ZEO-KARB®)
WEAKLY BASIC ANION EXCHANGER (DE-ACIDITE®)
VACUUM DEAERATOR
PERMUTIT
TREATED WATER TO SERVICE
ION EXCHANGE AND WATER CONDITIONING HEADQUARTERS FOR OVER 40 YEARS

WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL
INDUSTRIAL WASTE TREATMENT

COMING ARTICLES

The New Softening and Iron Removal Plant of Dayton, Ohio.....*Howson*
Atlanta's New Central Dispatcher's Office for Water Works.....*Weir*
Problems in Small Water System Operation and Their Solution.....*Dietrick*
The Control of Sand in Water Systems.....*Rossum*
Simplifying the Selection of Main-Line Meters.....*Thorsen*
A Method for Solving the Canning Plant Waste Problem.....*Ingols*
Office Management in a Water Utility.....*Symons*
Pitometer Surveying of Distribution Systems.....*Hudson*
Designing Screen Chambers for Efficient Operation.....*Federick*
Operation of Small Water Works—Reorganization.....*Clark*

E. SCRANTON GILLETTE
Publisher

•

LINN HARRISON ENSLOW
Editor

•

HARRY A. FABER
Associate Editor

Assistant Editor F. C. MAURER
Make-Up Editor W. W. VANSTONE

Editorial Associates
A. M. RAWN J. R. BAYLIS C. E. KEEFER
L. L. HEDGPETH

EXECUTIVE OFFICE
185 North Wabash Ave., Chicago 1, Ill.
E. S. GILLETTE, President
H. J. CONWAY, Sec.-Treas. & Adv. Dir.

EDITORIAL OFFICE
155 E. 44th St., New York 17, N.Y.
LINN H. ENSLOW, Vice Pres. & Editor
H. A. FABER, Assoc. Editor
F. C. MAURER, Ass't. Editor
S. H. RYAN, Secy. to the Editor

BUSINESS OFFICES

Chicago Office
185 North Wabash Ave.
W. W. Hamilton,
Western Mgr.

New York Office
155 E. 44th St.
F. A. Michel, Eastern Mgr.
Wm. R. Joyce, Mgr. Central Distr.
F. C. Maurer

Copyrighted 1954 By Scranton Publishing Co.

"WATER WORKS PRACTICES" are discussed in a continuing series of articles by *"Doc" Symons.*

"SEWAGE WORKS PRACTICES" are discussed in a companion series of articles by *Prof. Don Bloodgood*

VOL. 101 **February, 1954** No. 2

Sewage and Industrial Waste Developments During 1953 45
by F. W. Mohlman, *Chicago, Ill.*

Sewage Works Practices 55
No. 7—Imhoff Tank Operations
by Don E. Bloodgood, *Lafayette, Ind.*

Bulk Storage of Liquid Chlorine 60
by J. S. Long, *Tampa, Fla.*

Miami Host to Florida A.W.W.A. Section at 27th Annual Conference 64

Water Works Practices—Source of Supply
Part VII—Well Capacity and Development 69
by George E. Symons, *Larchmont, N.Y.*

Water and Sewage Improvements at Waterville, Maine 72
by J. Elliott Hale, *Waterville, Me.*

Determining Residual Chlorine in Water by Neutral Ortho-Tolidine Methods 74
by A. T. Palin, *Newcastle upon Tyne, England*

The Mobilization Readiness Program 77

Wash Water Measurement in Filtration Practice 78
by Robert W. Angus, *Toronto, Canada*

Water Purification Upset Seriously by Detergents 80
by A. R. Todd, *Wheeling, W. Va.*

The Magnetic Oxygen Analyzer in Studies of Oxygen Uptake 81
by Sam R. Hoover, Lenore Jasewicz and Mandor Porges, *Philadelphia, Pa.*

Safety in Sewage Works Maintenance and Operation (Part VII) 84
by LeRoy W. Van Kleeck, *Hartford, Conn.*

Report of the S&IW Federation's 26th Annual Meeting in Miami (Part III) 89

The Curse of Low Water Rates: Can We Break It? 94

Meetings Scheduled 86A

Manufacturers' and Equipment Items 95A

Literature and Catalog 120A

Published Monthly—subscriptions in the U.S., Canada and Latin America $2.00 per year: Foreign $3.00. Single copies 25c
(Member—Audit Bureau of Circulation and Associated Business Publications, Inc.)

SUPERIOR and ATLAS DIESELS...

efficient sources of dependable power for essential community services

EMERGENCY STANDBY POWER

WATER SUPPLY

SEWAGE DISPOSAL

MUNICIPAL POWER

For more than a quarter century Atlas and Superior Diesels have been serving municipalities of every size—supplying power for operating all kinds of essential utilities.

The records from thousands of these diesel engine installations, in all parts of the world, point up the dependability and efficiency of Superior and Atlas Diesels.

Officials concerned with the utility power needs of their communities will find these reports revealing from the standpoint of operating economics and efficient overall performance. Full details on the applications of Atlas and Superior Diesels can be obtained from any one of the *Engine Division offices listed below*, or from headquarters at Springfield.

DIESEL DUAL FUEL GAS

ATLAS Imperial DIESEL ENGINES

Superior ENGINES

DISTRIBUTOR OF Lister DIESELS IN U.S.A.

THE NATIONAL SUPPLY COMPANY

ENGINE DIVISION PLANT AND GENERAL OFFICES: SPRINGFIELD, OHIO

SALES AND SERVICE POINTS: Gloucester, Massachusetts • Houston, Texas • Fort Worth, Texas • San Diego, California Oakland, California • Terminal Island, California • Ketchikan, Alaska • Washington, D.C. • Chicago, Illinois • Portland, Oregon • Astoria, Oregon • Casper, Wyoming • Halifax, Nova Scotia • Vancouver, B.C. • Toronto, Ontario • Park Rapids, Minnesota • New York, New York • Seattle, Washington • New Orleans, Louisiana • Pittsburgh, Pennsylvania

X-371

Lithographed on stone for U. S. Pipe and Foundry Co. by John A. Noble, A. N. A.

THIS ILLUSTRATION showing the installation of U.S. mechanical joint pipe in a residential area is a typical scene. It could be either a water, gas or sewer line installed to furnish reliable utility service for present and future generations in the community.

U.S. cast iron pipe centrifugally cast in metal molds is a quality product produced by a modern casting process which is carefully controlled from raw material to the finished pipe.

We are well equipped to furnish your requirements for cast iron pipe and fittings made in accordance with American Standard, American Water Works Association and Federal specifications. U.S. pipe centrifugally cast in metal molds is available in sizes 2- to 24-inch and pit cast pipe in the larger sizes.

United States Pipe and Foundry Co.,
General Office, 3300 First Ave., N. • Birmingham 2, Ala.
Plants and Sales Offices Throughout the U.S.A.

U.S.
cast iron
PIPE
AND INDUSTRIAL SERVICE

A quick switch and here's the Hydrocrane — setting water pipe. Telescoping boom permits reaching for extra footage — without moving crane an inch!

Here the Hydrohoe digs a pipe trench. By telescoping boom operator can peel off scallops at grade level — dig a smooth, even trench.

Quick Boom Switch

GIVES YOU A MONEY-SAVING CRANE-HOE TEAM

Owners report that Hydrocrane and Hydrohoe booms can be switched in less than an hour. This exceptional convertibility can save time — mean additional savings for you. For example you can dig trenches or valve pits in the morning — convert to crane front end — and set pipe, valves or hydrants in the afternoon.

With this quick, simple convertibility the two front ends can work as a team right on the same job.

In addition to this top speed convertibility, the all-hydraulic Hydrocrane offers you:

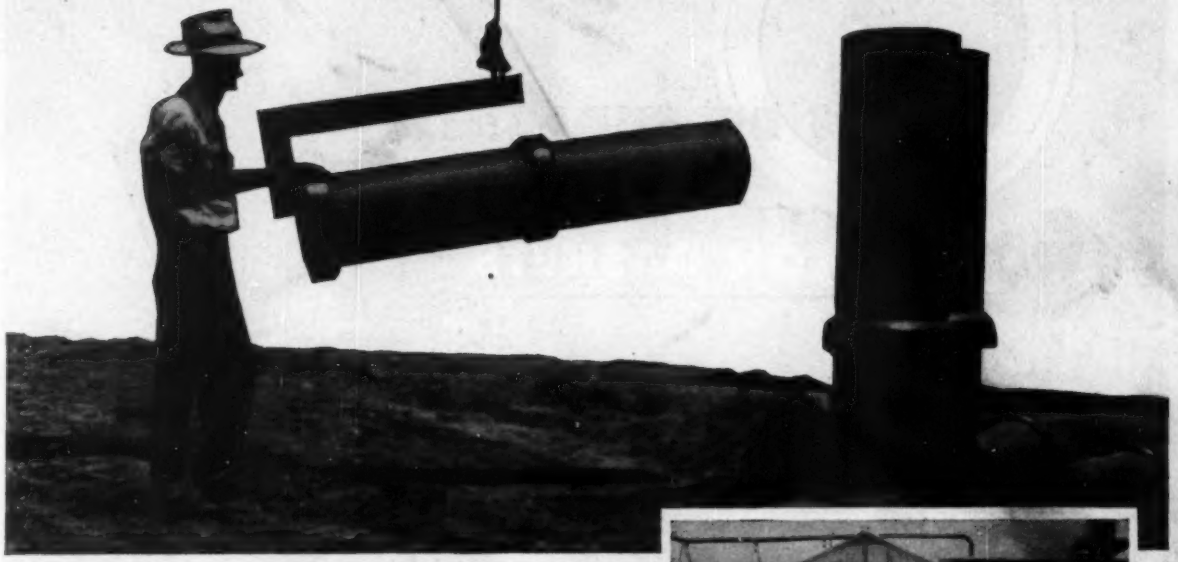
- **50 mph travel speed**
- **Quick-set hydraulic outriggers**
- **Simple, hand lever control — no foot brakes**
- **Telescoping boom**
- **Safety and exact precision of hydraulic operation**

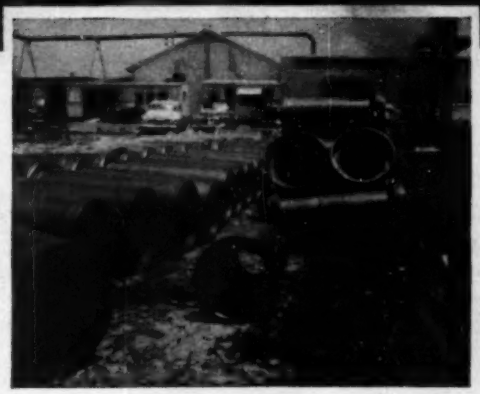
See your distributor for a demonstration. We'll be glad to send you his name. 43H53

BUCYRUS ERIE SOUTH MILWAUKEE, WISCONSIN

When Sewerage Projects are Bond-Financed...

Look for Vitrified CLAY PIPE





When a municipal sewerage project is financed by bonds that won't mature until 1993, the pipe has to be good. It *must* not fail—especially before the bond issue has been retired. That's why city officials and sewerage contractors all over the country confidently specify, buy, and install Vitrified Clay Pipe. They know Clay Pipe is the *only* pipe . . .

- **Completely unaffected by sewage acids and corrosive industrial wastes . . .**
- **Sure to last regardless of the fluids that may flow through it in the future . . .**
- **Guaranteed for 50 years!**

The $27 million bond issue launched by the city of Miami will cover long-needed sewerage improvements that will require hundreds of thousands of feet of Vitrified Clay Pipe. In the 79th St. installation shown here—a small part of the overall project—some 12,000 feet of Clay Pipe were installed. City of Miami officials who directed various phases of this project are: Engineer Arthur E. Darlow, Inspector Frank Allen, and Supervisor of Sewer Design W. B. Lewis. Under the direction of General Contractor Joe Reinertson, Inc., were Design Engineer W. T. Eefting, Job Superintendent Tom Bryson, and Superintendent of Construction Inspection Fred Righter.

Vitrified
CLAY
PIPE

NATIONAL CLAY PIPE MANUFACTURERS, INC.
1520 18th St. N. W., Washington 6, D. C.

206 Connally Bldg., Atlanta 3, Ga.
100 N. LaSalle St., Rm. 2100, Chicago 2, Ill.
703 Ninth & Hill Bldg., Los Angeles 15, Calif.
311 High Long Bldg., 5 E. Long St., Columbus 15, Ohio

C-134-1

Gasket characteristics:

- self lubricating
- can't bind
- unique shape maintains lubricant release
- pressure tight

Round Port Valves—100% Obstruction Free • Rectangular Port Valves with Full Pipe Area • Venturi Valves for Economy

Now standard on a.c.f. Lubricated Plug Valves, this exclusive a.c.f. development gives protection against head leakage at high pressure and at temperatures up to 450° F. Greatly reduces turning torque. Increases service life without materially affecting price.

Four years of field service tests under most exacting conditions have confirmed the effectiveness of this new discovery. Get all the facts from your nearby a.c.f. valve representative.

a.c.f.

Representatives in 50 Principal Cities

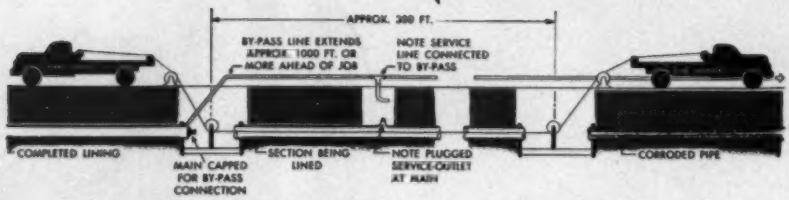
CYLINDRICAL FULL PIPE AREA

PLUG VALVES

Write for Catalog No. 4-WS and Price List. American Car and Foundry Company, Valve Division, 1501 E. Ferry Avenue, Detroit 11, Michigan

this ***is an Indian peace pipe...***

The American Indian knew the pleasures to be obtained from smoking long before the European world. He fashioned his crude pipe stem from cane, reed or bone and the bowl from stone, clay or hard wood. But contemporary Indian fighters who tried smoking the peace pipe reported it took a lot of lung power to draw through the rough stems. Compared to our modern pipe, smoking was hard work . . . and not the pleasant, "easy-draw" smoking pipe smokers enjoy today.


APPROX. 300 FT.
BY-PASS LINE EXTENDS APPROX. 1000 FT. OR MORE AHEAD OF JOB
NOTE SERVICE LINE CONNECTED TO BY-PASS
COMPLETED LINING
MAIN CAPPED FOR BY-PASS CONNECTION
SECTION BEING LINED
NOTE PLUGGED SERVICE-OUTLET AT MAIN
CORRODED PIPE

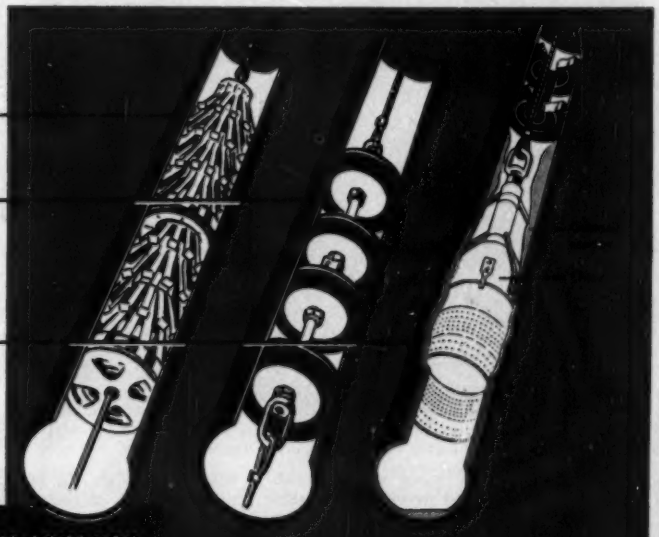
this ***is a pipe lining operation...***

. . . applicable to water, oil or gas pipe lines. . . using the Tate Process to renew old iron and steel pipe *"in place,"* up to 16" dia., with only temporary interruption of service while by-pass sections are installed.

this *is the steel scraper* . . . pulled through the pipe to dislodge all tubercles and incrustation.

this *is the rubber swabber*...drawn through the pipe after the scraping operation to make sure pipe is clean and smooth and all loosened material is removed.

this *is the Tate Process liner* . . . it squeezes cement mortar inside onto the pipe walls, making a smooth, continuous water proof lining for free, fast flow.



When your underground pipe line looks like this

The Tate Process makes it look like this!

CEMENT MORTAR LINING GIVES YOU

- New pipe performance!
- Restores flow coefficients!
- Reduces pumping and maintenance costs!
- Prevents leakage!
- Protects against corrosion, contamination and discoloration!
- At much less than the cost of installing new pipe!

PIPE LININGS, Inc., P.O. Box 457, Wilmington, California

( ) Please send complete information on how to obtain new pipe line performance from our old pipe.

( ) Please have one of your hydraulic engineers see me.

Name_____

Title_____

Company_____

Address_____

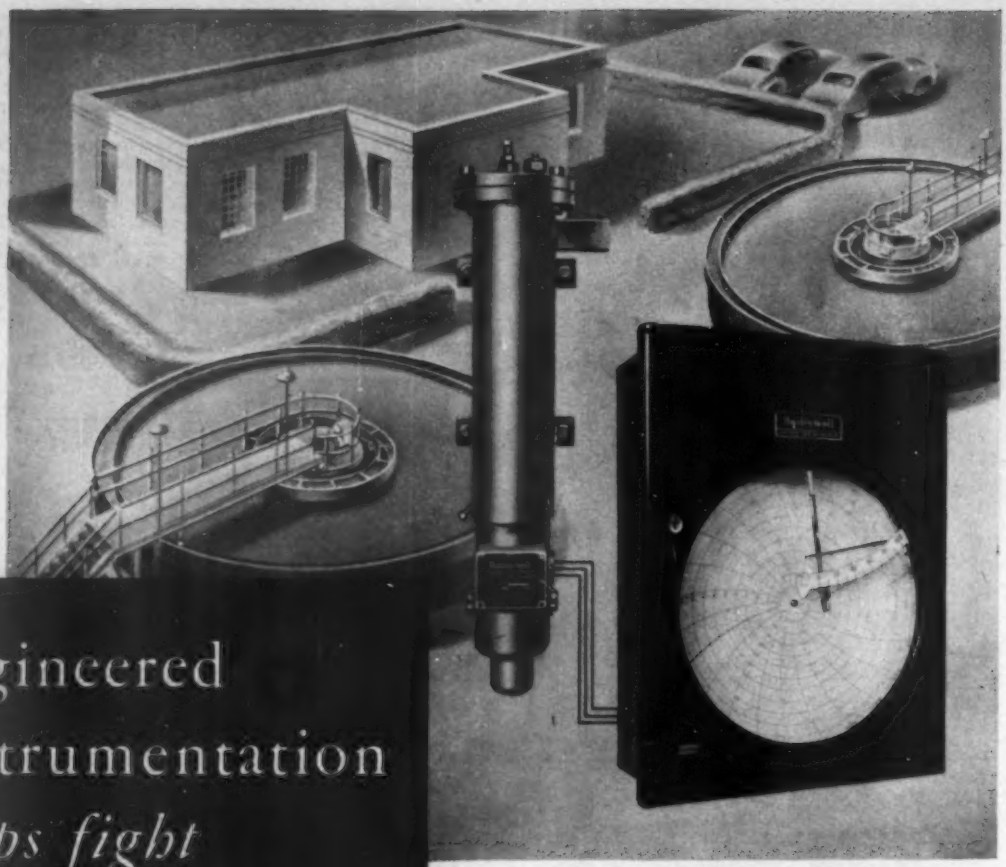
City_____ State_____

PIPE LININGS, Inc.

(A subsidiary of American Pipe and Construction Co.)

2414 East 223rd St., Wilmington, Calif.

Rail Address: Watson, California



engineered instrumentation *helps fight stream pollution*

PLAN FLOW INSTRUMENTATION FOR THE FUTURE *—by selecting the Brown Evenly Graduated Flow Meter. This instrument provides accurate measurement at fractional-scale readings—gives full precision when your plant is running at part load, and after it has grown to final capacity.*

WHEREVER your waste treatment plant needs to measure and totalize flow—of plant influents, effluents, filter backwash water, gas, carbon dioxide, and numerous other fluids—you'll find the Brown Evenly Graduated Flow Meter the ideal solution to your problems.

Its linear scale and chart are uniformly accurate and readable across the entire range . . . are free from the difficulties of reading compressed markings near the zero point. Built-in electronic integration adds up total flow accurately for convenience in flow cost accounting and process analysis. The instrument is supplied as an electric type for remote recording, or as a mechanical meter with direct-coupled meter body.

The Brown Flow Meter embodies simple, rugged construction in every detail. The meter body is corrosion resistant, light-weight and sturdy. And to assure you of continuous performance, Honeywell's widespread organization offers prompt, experienced service.

Your local Honeywell engineering representative will be glad to discuss your plant's instrumentation requirements with you and your consulting engineer . . . to apply the experience which Honeywell has gained through years of work in this field. Call him today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4575 Wayne Ave., Philadelphia 44, Pa.

● REFERENCE DATA: Write for Catalog 2300, "Evenly Graduated Flow Meters"

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls

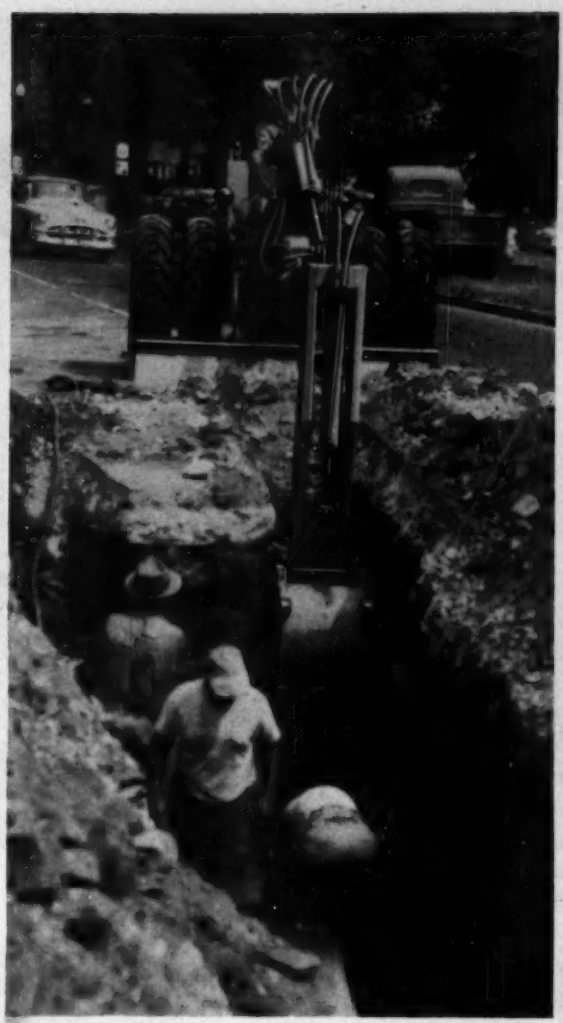
NEW OLIVER 88WT Hydro-Trencher

Digs to 10 feet in toughest going!

Here is a trencher that won't stop when it comes to rocks or roots. Tremendous hydraulic down pressure forces the half-yard bucket into the ground for a fast, full load. New dual-circuit control gives constant pressure, more positive control and greater flexibility in any kind of going.

Take a close look at this new trencher. It reaches long and digs deep. Its simple, sturdy construction and all-hydraulic operation give low maintenance and long service. The hydraulic stabilizer blade not only holds the tractor level and steady, but is an excellent back-filler blade. And, by simply turning the trencher bucket around you have an efficient swing loader.

Test the new Oliver 88WT Hydro-Trencher on your work. See how easy it is to operate and how readily it digs or loads the toughest material. And remember, the 88WT is ready to work or move instantly, and takes only one man to operate. Get in touch with your Oliver Industrial Distributor for a demonstration, soon!



Right through the roadbed! Powerful hydraulic down pressure digs through this material with ease. Positive dual-circuit control gives a choice of *three* separate lift or drop speeds on the boom for any condition. Bucket rotation and dipper stick design permit clamping rocks larger than the bucket itself. Special boom cylinder available for digging to 12 feet.

It's a swing loader, too! Remove the bucket hinge pin and turn the bucket around. In minutes the trencher becomes a loader. No extra parts are needed. The exceptional bucket rotation permits loading into a truck up to 10 feet, 6 inches. Optional loading bucket loads up to 12 feet.

One-half yard bucket! The fast hydraulic operation and big bucket capacity of the 88WT let you do more in less time. All-hydraulic operation means, too, that there are no expensive cables or clutches to replace. Maintenance is simple and low cost.

THE OLIVER CORPORATION

400 West Madison Street, Chicago 6, Illinois

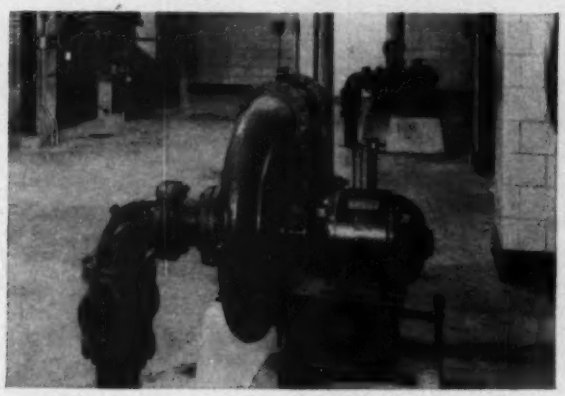
AERIAL VIEW of Baltimore treatment plant shows layout of settling tanks and filters. The plant, serving the Baltimore area, handles an average of 130 mgd. Architect was Lucius R. White; general contractor was the Chesapeake Contractors.

Baltimore's modernized sewage plant

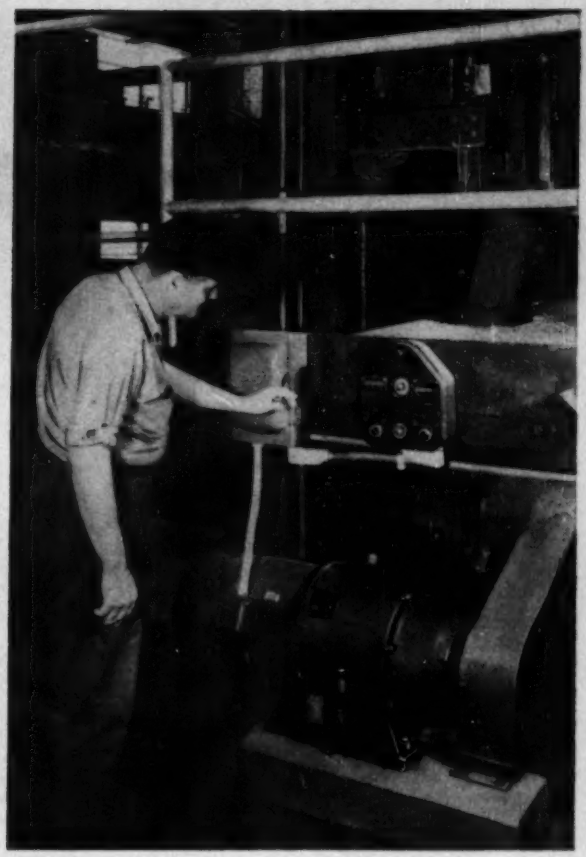
MAIN PROCESS CONTROL panel for the sludge-drying plant is this G-E Cabinetrol* panel. G-E Apparatus Sales engineers helped to plan installation to fit the exact needs of the plant.

*Reg. trade-mark of General Electric Co.

VAPOR FAN, driven by 60-hp G-E motor, removes moist air from cyclone and discharges it into the furnace for drying.



GAS BOOSTER, driven by G-E 7½-hp motor, increases pressure of gas coming from digester tanks for plant utilization.



EFFICIENT DRIVE for the mixer is supplied by this economical, easily maintained 15-hp G-E gear-motor.

brings CLEAN WATERS to Back River

G-E equipped sewage treatment plant expansion completes sludge-drying project for the city

In January, 1953, Baltimore's newly modernized drying plant went into full operation. Owned and operated by the city of Baltimore, it was built to safely handle the city's waste and to help decontaminate the Back River, making it safe for recreation. This one plant handles the major part of the entire Baltimore area.

Consulting engineers Whitman, Requardt & Associates and electrical contractor Blumenthal Kahn Electric Co. utilized G-E application engineering aid in specifying and installing the G-E Cabinetrol panel, which controls power distribution of low-voltage power for the drying plant.

SPECIALISTS IN SEWAGE-PLANT ELECTRIFICATION, G-E application engineers are ready to work with *your* engineers and consultants and contractors to help design a co-ordinated electrical system for your new plant or modernization project. Contact your local G-E Apparatus Sales Representative early in the planning stage. And to gain public support for your new sewage facilities, ask him now how you can put the G-E "More Power to America" film, CLEAN WATERS, to work in your community. General Electric Co., Schenectady 5, N. Y. 660-81

Engineered Electrical Systems for Sewage Plants

GENERAL ELECTRIC

BUCKLIN POINT SEWAGE TREATMENT PLANT

EAST PROVIDENCE, R. I.

Blackstone Valley Sewer District

METCALF & EDDY
ENGINEERS

BOSTON, MASS.

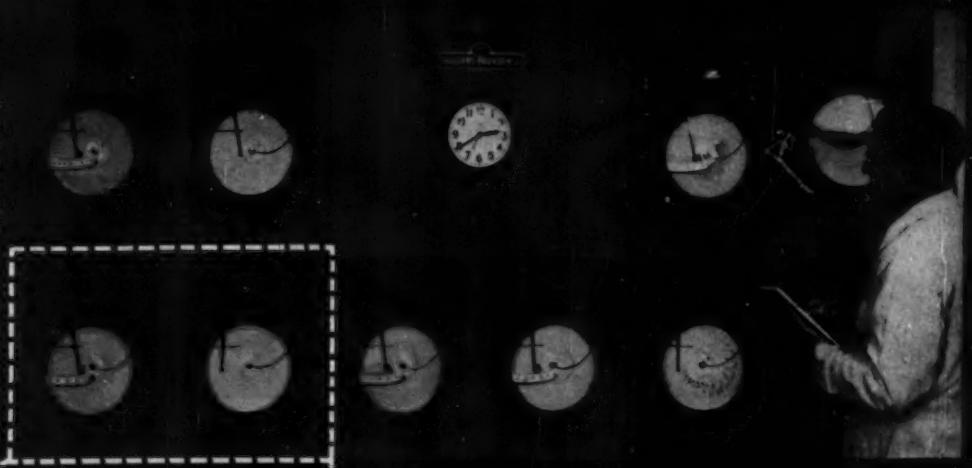
❶ View of Bucklin Point Sewage Treatment Plant showing preliminary settling tanks Nos. 1 and 2 in left foreground; sludge pumping station and dewatering and service building to left center; screen and grit building at right, in front of digestion tanks and digestion control building.

Perhaps the outstanding pollution abatement battle in New England is being waged by Rhode Island's Blackstone Valley Sewer District Commission. At Bucklin Point has been built the first stage of a fully integrated sewage interception and primary treatment system which ultimately will be capable of handling a total sewage flow (including industrial wastes) of 47 MGD.

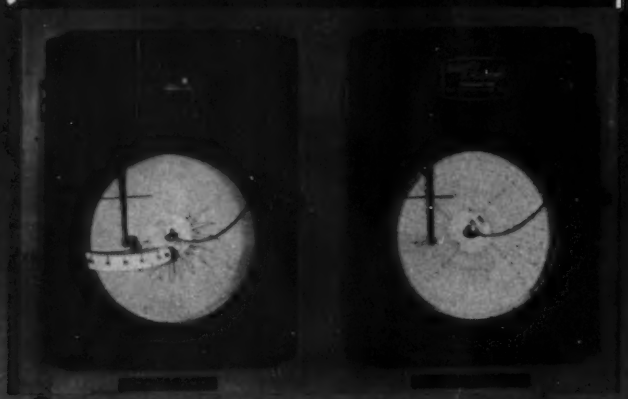
The Bucklin Point Plant was designed by Metcalf and Eddy and built by F. H. McGraw & Co. of Hartford, Conn. under the immediate direction of the Blackstone Valley Sewer District Commission headed by W. J. Halloran. Metcalf & Eddy also served as consultants during the construction program. To obtain a detailed description of Builders Metering and Chlorinating Equipment furnished for the Bucklin Point Plant, write Builders-Providence, Inc. (Division of B-I-F Industries, Inc.), Providence, Rhode Island.

❷ Chronolo Indicator in Chlorine Control Building shows summated total of sewage flow through two Parshall flumes, enabling operator to set proper chlorine dosage.

BUILDERS-

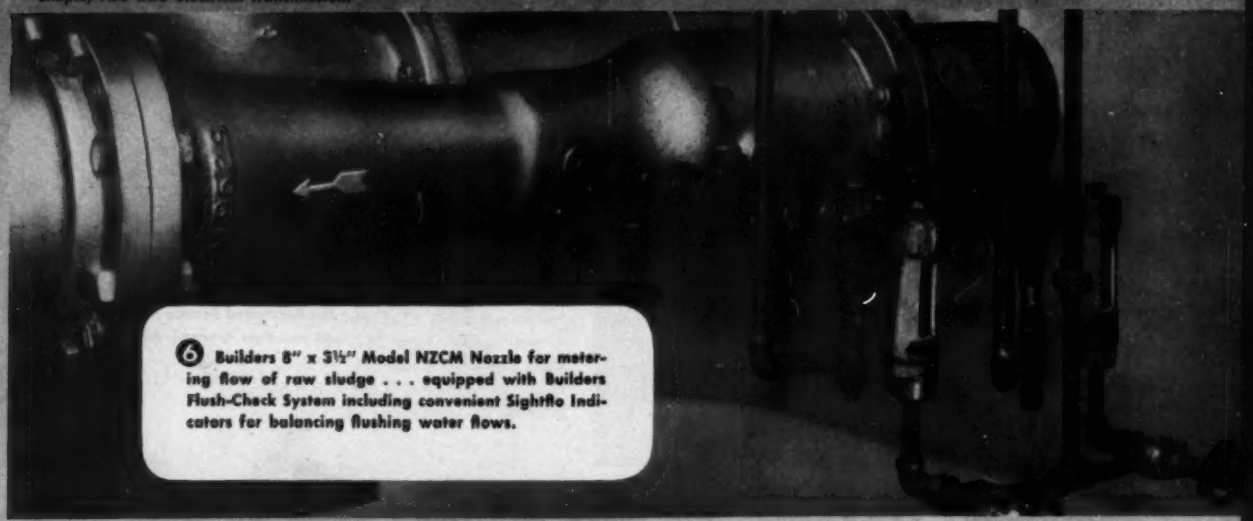


3 Main Panel in Administration Building. Reading from left to right, meters include two raw sewage influent meters and two instruments for recording submergence of raw sewage Parshall flumes; total sewage meter; total air meter; air-sewage ratio meter; Omega Pumping Station flow meter; and meters for recording chlorine rate and outside air temperature.



4 Close-up of East Providence Interceptor flume meter (Chronoflo Totalizer-Recorder with pen arm indicator) at left and submergence meter (Chronoflo Recorder) at right. Submergence instrument permits correction of influent meter according to degree of submergence of Parshall flume. All major instruments in the Plant are Builders Chronoflo, utilizing simple, two-wire electrical transmission.

5 Builders Visible Flow Chlorinators at Bucklin Point — Model HCVS, capacity 100 to 6,000 lbs. per 24 hr. each. These Chlorinators, originally installed for interim disinfection of raw sewage before discharge into the Seekonk River, were earning money for the Blackstone Valley Sewer District Commission even before the plant was in complete operation.



6 Builders 8" x 3½" Model NZCM Nozzle for metering flow of raw sludge . . . equipped with Builders Flush-Check System including convenient Sightflo Indicators for balancing flushing water flows.

PROVIDENCE

PIONEERS IN METERS AND CONTROLS

Why research never says: "let well enough alone"

Anyone might fairly assume that cast iron pipe which has served, and is still serving, over 50 American cities for more than a century, is as efficient and economical as pressure pipe can possibly be. Our member Companies have not been content to rest on that assumption.

By continuous research and development, they have attained, in *modernized* cast iron pipe, greater toughness, strength and uniformity to a point resulting in still greater efficiency and economy.

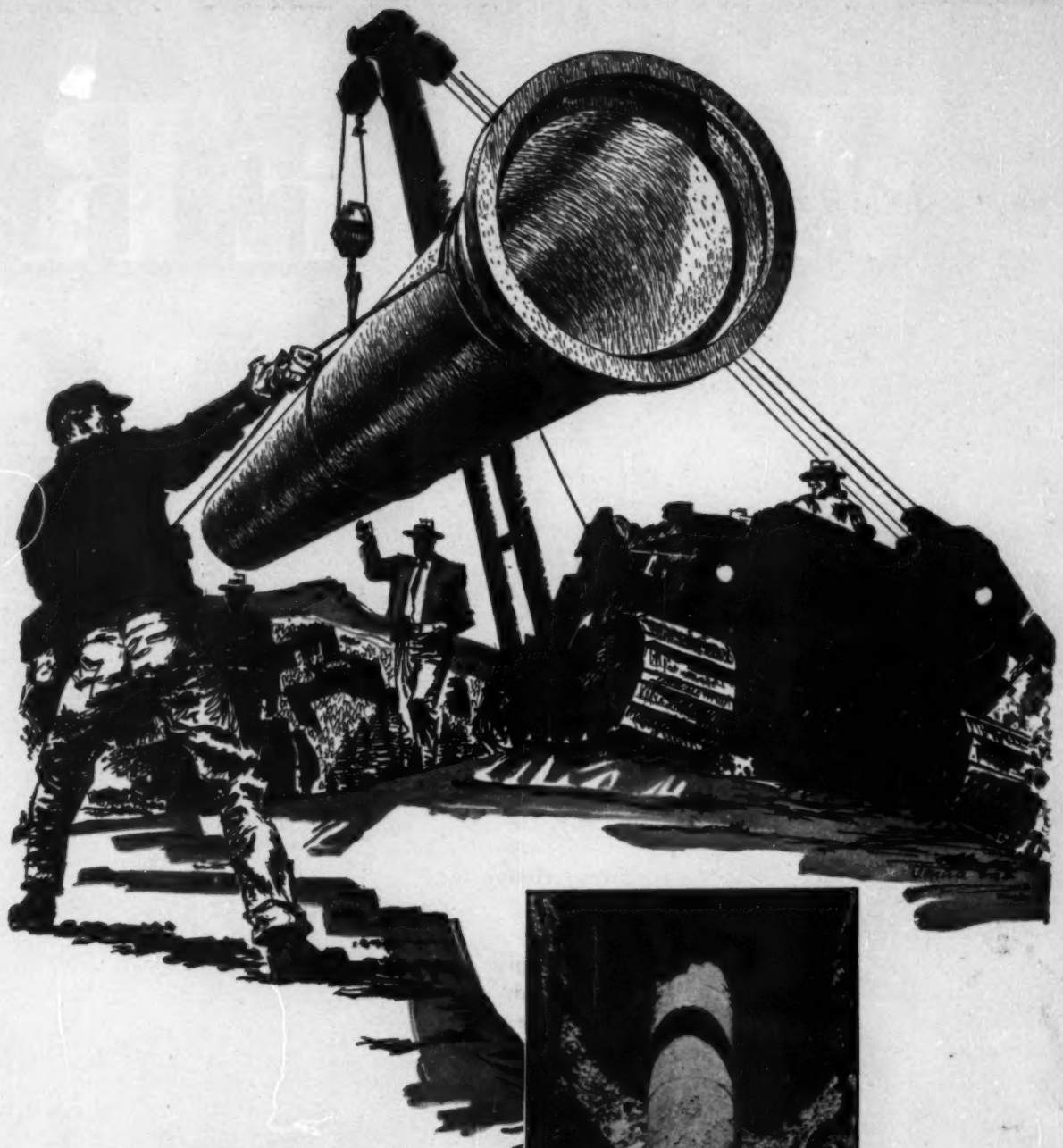
***Modernized* cast iron pipe is centrifugally-cast. Where needed and specified, it is lined with cement mortar centrifugally applied, resulting in a tuberculation-proof pipe with sustained carrying capacity and, therefore, reduced friction loss and pumping costs.**

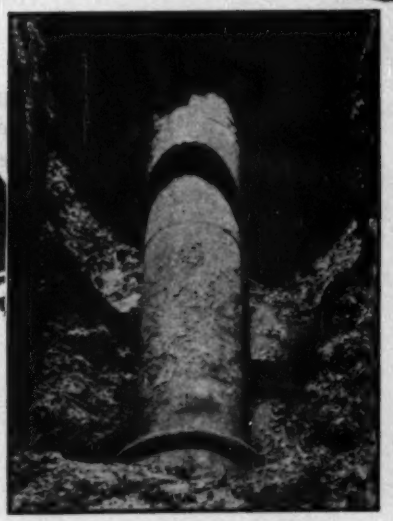
If you want the most efficient and economical pipe ever made for water distribution, your new mains will be laid with *modernized* cast iron pipe with either mechanical or bell-and-spigot joints. Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3.

CAST Q IRON

The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

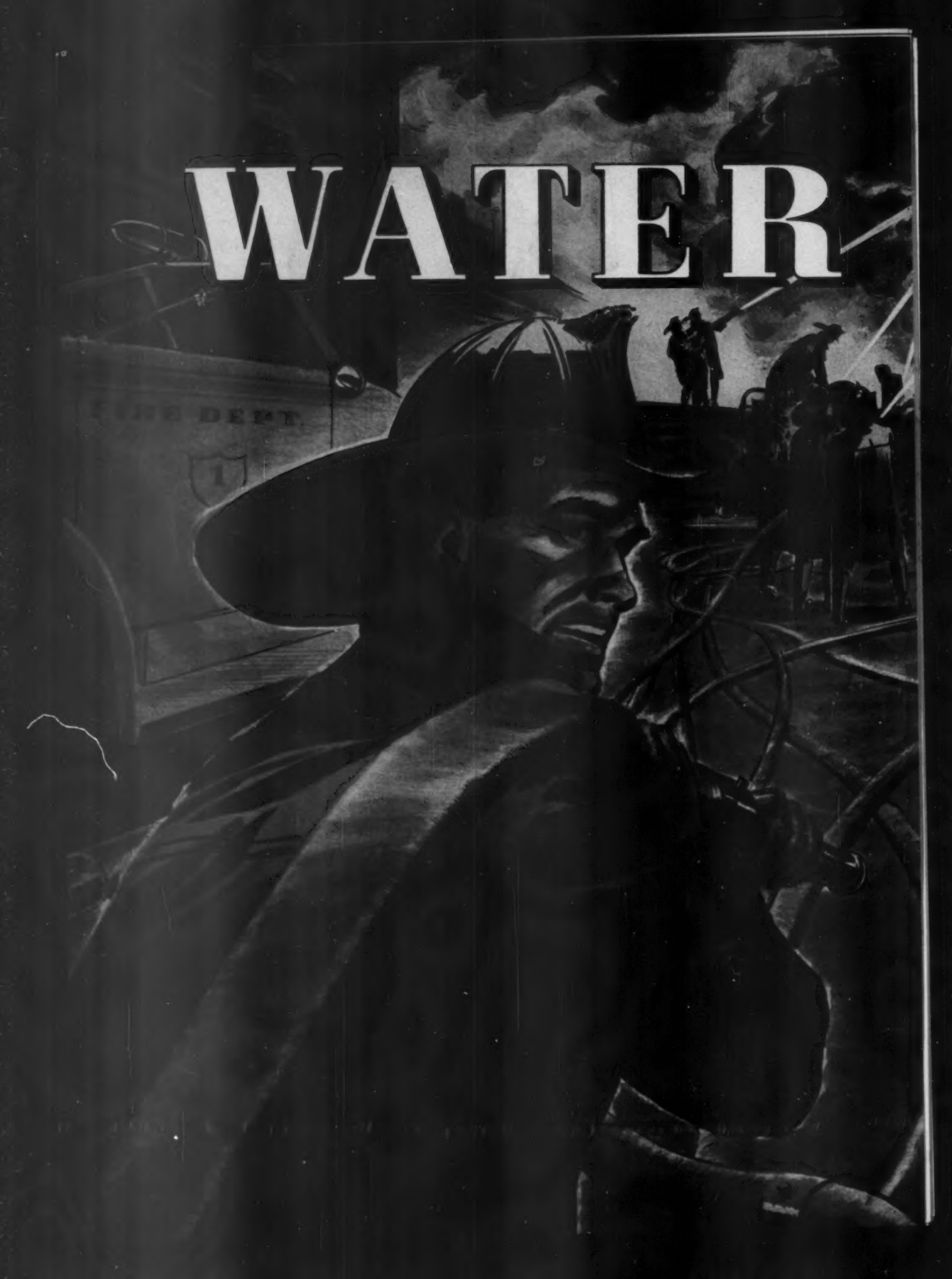
Modernized **cast iron**



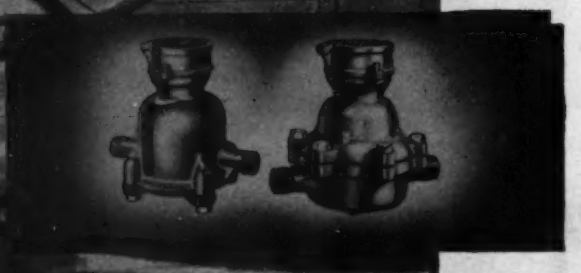


This cast iron water main, uncovered for inspection, is in good condition after 100 years of service in Alexandria, Va.—one of more than 50 cities with century-old water or gas mains in service.

pipe for Modern Waterworks Operation


WATER

is vital...



BADGER meters conserve it!

Water saves lives in emergencies... and millions of gallons are required for fire-fighting alone each year. Badger water meters help thousands of communities to conserve water for such needs... measure water precisely for homes and industry . . . provide an accurate check on water usage and water waste. And the record of Badger meter performance, known everywhere, has caused thousands of waterworks men to say—"It pays to choose Badger!"

BADGER WATER METERS

BADGER METER MFG. CO., Milwaukee 45, Wisconsin

"Measuring the water of the world"

YOU'LL FIND

TYLOX

flexible

RUBBER PIPE JOINTS

Tough

Rubber Tylox compensates for angularities in the line—permits immediate backfilling.

THAT'S WHY ENGINEERS AND CITY OFFICIALS CHOSE TYLOX PIPE JOINTS FOR THE NEW SEWERAGE OUTFALL IN GADSDEN, ALABAMA

Deep trenches, sandy soils and an under-water effluent were some of the problems faced on the Gadsden job* . . . The city wanted a long-lasting, low-maintenance line — built within the budget; the engineers wanted non-deteriorating pipe joints that would stay tight through the years; the contractors wanted *fast* pipe-jointing to help offset higher construction costs.

On all counts the requirements were met—efficiently and economically—with TYLOX Gaskets, the RUBBER Pipe Joints that don't have to be "dug up" for future repairs . . . that *stay leakproof* "for the life of the line" . . . that enable contractors to lay pipe with cost-saving speed.

TYLOX Gaskets are the *one* pipe jointing material that meet requirements of engineers, sanitary officials and construction men alike. Write for complete details. We'll include illustrated case histories which, like the Gadsden job, are typical of the many TYLOX-protected sewerage systems all over the country. Read the facts for yourself — and take advantage of TYLOX RUBBER JOINTS on *your* next pipe job.

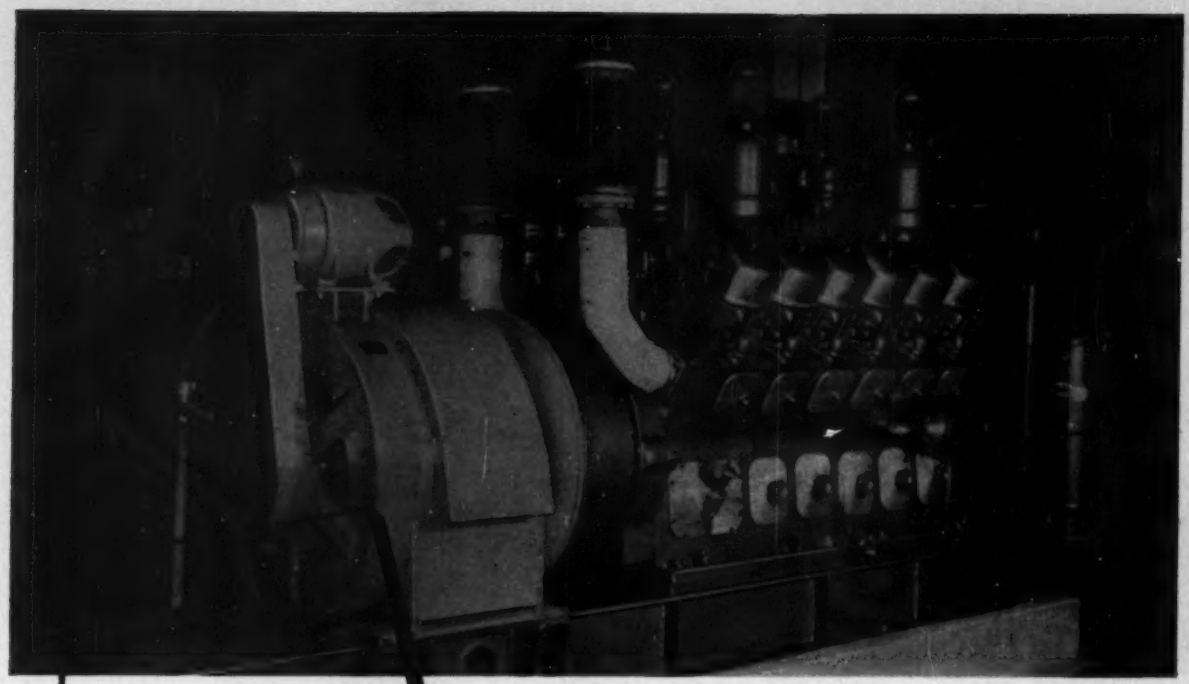
HAMILTON KENT
MANUFACTURING COMPANY
KENT, OHIO
427 W. Grant St. Tel. 3449

* **PROJECT: 3,832 ft. waste outfall sewer.**

PIPE: Reinforced concrete, sizes 36" through 60" diameters. Manufactured by: Universal Concrete Pipe Company. Supplied by: Gadsden Concrete Pipe Company

ENGINEERS: McGeorge, Hagerty & Associates, Cleveland, O.

CONTRACTORS: Daniels Construction Co., Birmingham, Ala.



Power for Prentiss, Miss. less than 5 mills per KWH!

. . . and LE ROI L3460 ENGINE saves enough on operating costs to pay for itself in about 3½ years

MUNICIPAL power requirements — for pumping, for generating electricity, for standby service — cost less with Le Roi engines. The Le Roi installation at Prentiss, Mississippi is a good example:

In order to meet the demands of an increasing electric load, Prentiss has supplemented its old diesel-powered generating plant with a Le Roi L3460. Burning natural gas, this Le Roi produces power for less than $0.005 per KWH — about one-half the cost with diesel power.

The Le Roi engine runs continuously in 600-700-hour periods between oil changes. Savings on fuel and lubricating oil amount to around $550 per month, allowing the Le Roi to pay for itself in about 3½ years.

Use dependable, low-cost Le Roi power to help ease the tax load in *your* community. Le Roi engines are available in sizes from 20 to 600 hp — custom generator sets in sizes from 50 to 300 KW. They operate on no-cost sewage gas, natural gas, butane, or gasoline.

E-85

Write today for detailed information

LE ROI

LE ROI COMPANY

Dept. WA-2 • 1706 S. 68th St. • Milwaukee 14, Wis.

A Subsidiary of Westinghouse Air Brake Co.

Plants: MILWAUKEE CLEVELAND GREENWICH, OHIO

Constant testing by Water Works Engineers and more than 67 years of experience in the designing and building of water meters have proven beyond doubt that there are no better meters made than

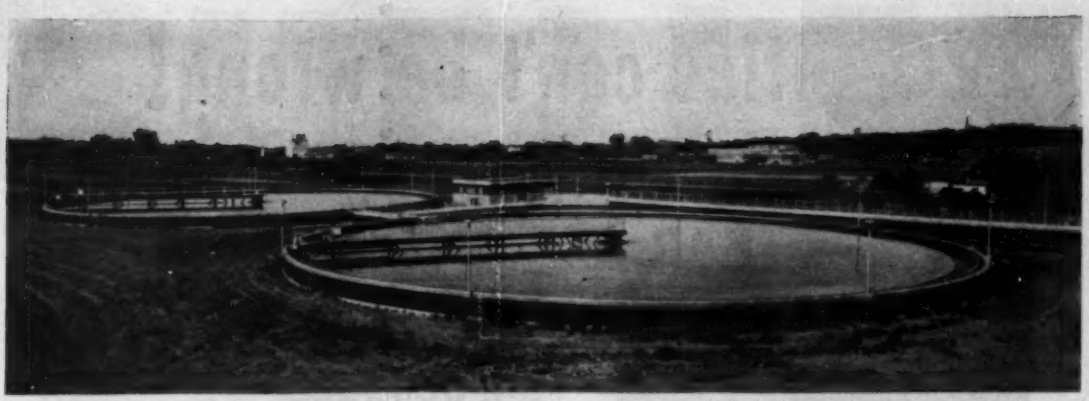
HERSEY WATER METERS

The best in water meters for every purpose

HERSEY MANUFACTURING COMPANY

SOUTH BOSTON, MASS.

BRANCH OFFICES: NEW YORK — PORTLAND, ORE. — PHILADELPHIA — ATLANTA — DALLAS — CHICAGO
SAN FRANCISCO — LOS ANGELES



Link-Belt Circuline sludge collectors, mechanically-cleaned bar screens and Straightline grit collector help provide 114 mgd peak load capacity at Denver sewage treatment plant. Black & Veatch, Consulting Engineers.

Denver adds 30 mgd of efficient sewage treatment capacity

LINK-BELT screens, sludge and grit collectors chosen for the job

FACED with growing population and increased industrial activity, the city of Denver recently enlarged its North Side sewage treatment plant from 54 to 84 mgd design capacity. And, as in so many other municipalities, Link-Belt equipment was specified for the major share of the work. Each of the Link-Belt units contributes greatly to dependable, efficient operation:

- Link-Belt mechanically-cleaned bar screens collect large floating solids, are easily kept clear to assure even flow.
- Link-Belt Straightline grit collector, 60x8x10 ft., settles and effectively collects the grit, keeps organic material in suspension so that it passes through the chamber.
- Two 150-ft. diameter Link-Belt Circuline sludge collectors provide quick, positive sludge and scum removal in the shortest time—without septicity . . . without maintaining any sludge blanket and with a sludge solids content as high as 13%.

The equipment used at Denver is part of the complete Link-Belt quality line. Our sanitary engineers will be glad to work with your engineers, chemists and consultants to give you the best in modern water, sewage or industrial liquids treatment equipment.

LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle; Scarboro, Toronto and Elmira, Ont. (Canada); Springs (South Africa); Sydney (Australia). Sales Offices in Principal Cities. 13.270

LINK-BELT

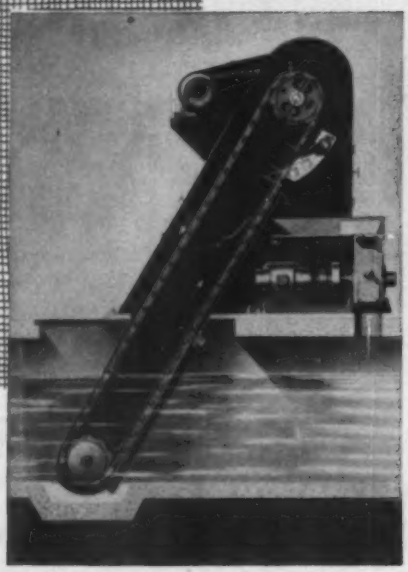
SANITARY ENGINEERING EQUIPMENT

220 Cities can't be wrong!

REX FRONT CLEANED BAR SCREENS ARE BEST

because

Yes, 220 cities with over 300 installations offer proof of the leadership of Rex Front Cleaned Bar Screens. For over 20 years Rex Screens have been satisfying customers throughout the United States and in many foreign cities. Here are some of the outstanding proven features of Rex Screens that make them leaders in their field.



- **Streamlined Construction**—unobstructed flow to rack-guarded chain—streamlined sprockets.
- **Rigidly Fastened Bar Rack**—bars accurately spaced—no obstructing cross members.
- **Solid Plate Rake** with machined teeth for positive cleaning of bar rack and greater capacity.
- **Positive Rake Wiping**—quiet—adjustable—prevents screenings carry-over to downstream side.
- **Rex Z-Metal Chain** and attachments—corrosion and wear resisting.
- **Split Head Sprockets**—easily removable.
- **Efficient Drive Unit**—fully enclosed—shear pin protection against overload.
- **Fully Enclosed Screen**—rugged design—neat appearance—easy removal of screenings.
- **Low Cost**—original operating—maintenance.

Your Rex District Sales Engineer can give you the details on all of the advantages of Rex Front Cleaned Bar Screens. Call him today, or if you prefer, write to Chain Belt Company, 4610 W. Greenfield Avenue, Milwaukee 1, Wisconsin.

CHAIN BELT REX COMPANY

Chain Belt COMPANY OF MILWAUKEE

Atlanta • Baltimore • Birmingham • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Dallas Denver • Detroit • El Paso • Houston • Indianapolis • Jacksonville • Kansas City • Los Angeles • Louisville Midland, Texas • Milwaukee • Minneapolis • New York • Philadelphia • Pittsburgh • Portland, Ore. West Springfield, Mass. • St. Louis • Salt Lake City • San Francisco • Seattle • Tulsa • Worcester

Distributors located in principal cities in the United States and throughout the world

EXPORT OFFICES: 4800 W. Mitchell St., Milwaukee; and 19 Rector Street, New York City.

MUELLER®

Install needed control valves without a shutdown!

Quickly and easily installed, these inserting valves are especially designed for installation and use where additional valving is required and a shutdown of the system would be impractical or hazardous.

When installed, the inserting valve may be operated like an ordinary gate valve to control a section of line. Mechanism of the valve is identical to that of standard Mueller AWWA Gate Valves and parts are interchangeable.

Inserting valves are available in 4", 6" and 8" sizes. The size of the valve corresponds to the size of the main. All valves have full-size seat openings.

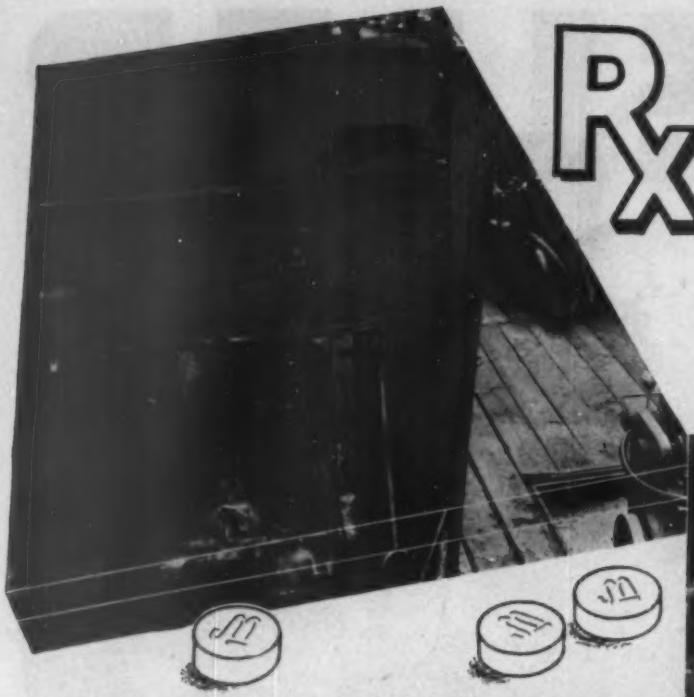
Basic inserting equipment makes it possible to insert valves in any existing line of corresponding size under pressure without loss of water.

Write for Catalog H-20 and H-602 today for complete details.

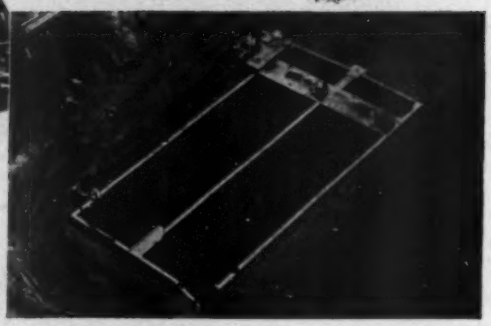
MUELLER CO.

Dependable Since 1857

2501 Chestnut St., Chattanooga, Tennessee



Rx for pollution headaches



Top photo: **Jeffrey Standard V-Bucket type Grit Collector removing grinding sludge from settling pits where used grinding solutions have been collected at Pratt & Whitney Aircraft plant, East Hartford, Conn.**

Above: **Jeffrey-equipped API Separator removing oil at same plant.**

Are state or federal anti-pollution laws giving you headaches? Then call on Jeffrey Sanitary Engineers for practical relief. A Jeffrey-designed installation will neutralize your industrial wastes efficiently. Here's how:

CHEMICAL DOSING: Jeffrey WAYTROLS, Bin Check Valves and Vibrating Feeders assure continuous, automatic dosage.

MIXING: Jeffrey Flash Mixers, with turbine type impellers, mix chemicals thoroughly with wastes.

FLOCCULATION: Jeffrey FLOCTROLS coagulate particles and promote rapid settling.

SETTLING: Jeffrey automatic, continuous Sludge Collectors scrape deposit to sump at end where it is pumped out and de-watered or sent to lagoons.

Hundreds of industrial wastes treatment plants throughout the nation are now Jeffrey-equipped. Scores of industries have found Jeffrey's wide engineering experience and broad line of proved equipment the best answer to pollution problems.

Write for descriptive literature.

THESE JEFFREY UNITS WILL HANDLE YOUR INDUSTRIAL WASTES:

- FLOCTROLS
- Bucket Elevators
- Bag Elevators
- Sludge Collectors
- Sludge Elevators
- Lime Pulverizers
- Grit Collectors & Washers
- V-Bucket Collectors
- Specific Gravity Separators
- Transmission Machinery
- Scum Removers
- Oil Separators
- Oil Skimmers
- Chemical Feeders
- Chains & Sprockets
- De-Watering Screens & Dryers
- Belt & Spiral Conveyors

THE JEFFREY MANUFACTURING CO.

ESTABLISHED 1877

Columbus 16, Ohio

sales offices and distributors in principal cities

PLANTS IN CANADA, ENGLAND, SOUTH AFRICA

IF IT'S MINED, PROCESSED OR MOVED . . . IT'S A JOB FOR JEFFREY!

. . . for many sewage treatment plants

The 40-foot diameter Hortonsphere shown is used for the storage of digester gas at the St. Joseph Sewage Treatment Plant in St. Joseph, Michigan. It is designed for a working pressure of 40 lbs. per sq. in. and has a capacity of 91,000 cubic feet.

Hortonspheres, similar to this one at St. Joseph, are used to store surplus digester gas at many modern sewage treatment plants. The digester gas, pumped into the Hortonsphere when the supply is plentiful and held under pressure, is used as a source of fuel to help provide heat, light and power as needed by the plant when the production of gas in the digesters is low. Digester gas thus used represents savings in fuel dollars.

Write our nearest office for estimates or quotations on a Hortonsphere for the storage of volatile liquids or gases at your plant. There is no obligation on your part.

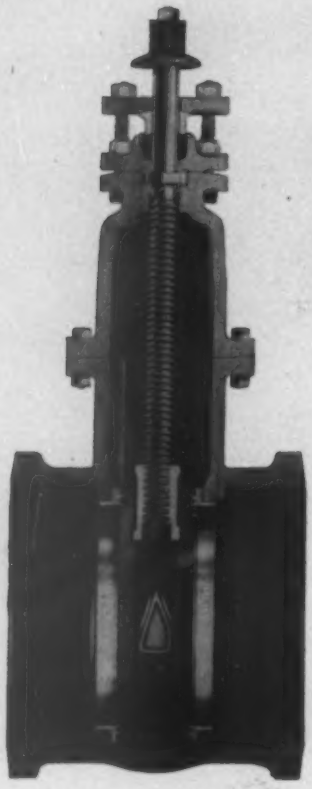
HORTON

WELDED STEEL
STORAGE TANKS

CHICAGO BRIDGE & IRON COMPANY

Plants in Birmingham, Chicago, Salt Lake City, and Greenville, Pa.

Atlanta 3	2181 Healey Bldg.	Los Angeles 17	1555 General Petroleum Bldg.
Birmingham 1	1386 North Fiftieth St.	New York 6	3390—165 Broadway Bldg.
Boston 10	1648-201 Devonshire St.	Philadelphia 3	1644—1700 Walnut Street Bldg.
Chicago 4	2190 McCormick Bldg.	Pittsburgh 19	3260 Alcoa Bldg.
Cleveland 15	2262 Midland Bldg.	Salt Lake City 4	550 West 17th South St.
Detroit 26	1551 Lafayette Bldg.	San Francisco 4	1582—200 Bush St.
Havana	402 Abreu Bldg.	Seattle 1	1350 Henry Bldg.
Houston 2	2115 C. & I. Life Bldg.	Tulsa 3	1646 Hunt Bldg.



Compare

POINT FOR POINT WHEN YOU BUY GATE VALVES

POINTS OF SUPERIORITY

1. Easy to operate—no binding of stem; wedges independent of stem and stem nut can't bind.
2. Stems and stem nuts both solid bronze.
3. Wedges, solid bronze in sizes 10" and larger. Wedges in these sizes have long and short wedging surfaces. Long side insures greater power in closing. Short side, maximum ease in opening.
4. Stuffing box bolts rust-proofed. Nuts bronze.
5. Easy to repack—ample stuffing box depth and diameter.
6. Minimum wear on rings—gates seat, unseat, in "fully closed" position.
7. Parallel, collapsible discs—no sticking in closed position or binding of stem due to tipping.
8. Interchangeable parts—due to precision casting and machining.

This is the valve with the famous Rensselaer wedge mechanism which is responsible for many of its superior operating and maintenance qualities.

When closing, the gates move freely to a position opposite their seats and are then wedged equally and firmly against the seats. The wedges are independent of the stem nut. No damage to threads, no binding, bending or misalignment. When opening, the first turning motion of the valve stem unlocks the wedges, and the gates swing free for easy, fast and complete opening.

Other superior qualities of this valve are given at the left and the Rensselaer Bulletin No. A gives a detailed description of the widely used A.W.W.A. type, and other types from 35 to 800 non-shock W.P. Special types for horizontal installations and the square bottom type recommended for frequent operation and for throttling purposes.

Rensselaer has developed a complete line of mechanisms for operation by hand, air, oil or water and electrical operation with many types of automatic control.

It costs more to dig up a valve, than to be sure that the valve is right in the first place. Thousands of these valves have been in service for more than fifty years. In many cases, "forgotten" valves that had never been closed for 25 to 40 years were "discovered" and found to be drop-tight.

Ask for Bulletin No. A and a list of the cities in your state which have standardized on Rensselaer.

O-RING SEAL AVAILABLE UP TO 12" SIZES 107

Rensselaer VALVE CO. TROY, N. Y.

GATE VALVES • FIRE HYDRANTS • SQUARE BOTTOM VALVES • CHECK VALVES • AIR RELEASE VALVES

SALES REPRESENTATIVES IN PRINCIPAL CITIES

Don't let CORROSION put the bite on *your* Sewage Plant this year

PROTECT WITH PITT CHEM!

Don't underestimate sewage corrosion! It's a silent, insidious destroyer, on duty three shifts a day. It takes a tough, heavy film of protective material to give you sure, long-lasting protection against it. Sewage engineers all over the country are specifying *Pitt Chem* Tar Base Coating for the job. *Pitt Chem* is easy to apply, protects metal, masonry and concrete from sewage 7 to 10 years longer than ordinary paint, and its cost fits even the most nominal maintenance budget.

A *Pitt Chem* engineer will be glad to show you how you can protect your investment in sewage plant equipment . . . at a small fraction of the equipment's cost. Why not call for an obligation-free *Pitt Chem* survey today.

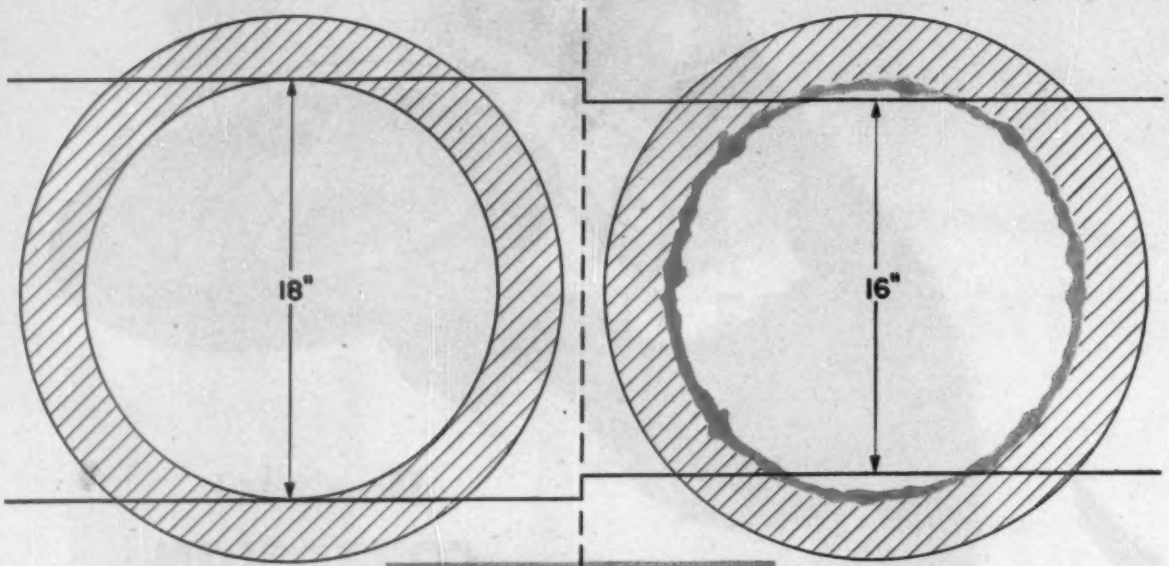
WAC 4994

PITT CHEM 101—For Severest Conditions
PITT CHEM 102—Maintenance Coating
PITT CHEM 103—General Purpose Coating
PITT CHEM 104—Potable Water Service
PITT CHEM 105 AQUATAR—A Water Dispersion
PITT CHEM 106 TARMASTIC—Sealing Compound
PITT CHEM 107 PACHKOTE—Specialty Coating
PITT CHEM 110—Specialty Coating

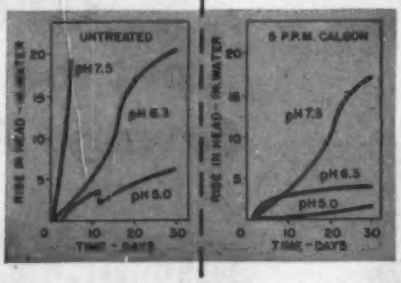
PITTSBURGH
COKE & CHEMICAL CO.

COAL CHEMICALS • AGRICULTURAL CHEMICALS • FINE CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

CORROSION CONTROL FOR WATER MAINS



Tuberculation not only results in permanent damage to the pipe, but restricts carrying capacity drastically.



In this case, flow in this 18" pipe was reduced from 4.8 mgd to 3.3 mgd by tuberculation within several months. The effective diameter of the 18" pipe was therefore reduced to only 16".

Calgon*

greatly reduces tuberculation ... more than pays for itself

A rapidly growing eastern municipality found that, due to tuberculation, the 18" main carrying their principal raw water supply had to be cleaned as often as three times a year. After each cleaning, despite treatment with lime and chlorine, the restored flow dropped off rapidly from 4.8 mgd to 3.3 mgd, at which point the main had to be cleaned again.

Then Corrosion Control with 3.0 to 3.5 ppm of Calgon was instituted, and rate of flow held up so well that now the main is cleaned only once a year.

A substantial reduction in cleaning costs, but this saving is only part of the story. In addition, this municipality has realized a saving of over $40 per day in pumping costs, and no red water complaints have been received since Calgon treatment was instituted.

Corrosion Control with Calgon is effective against tuberculation, and stabilizes dissolved iron and manganese. Corrosion Control with Calgon† is simple, effective, *and* economical. Let us tell you how Calgon can help you with *your* water problem.

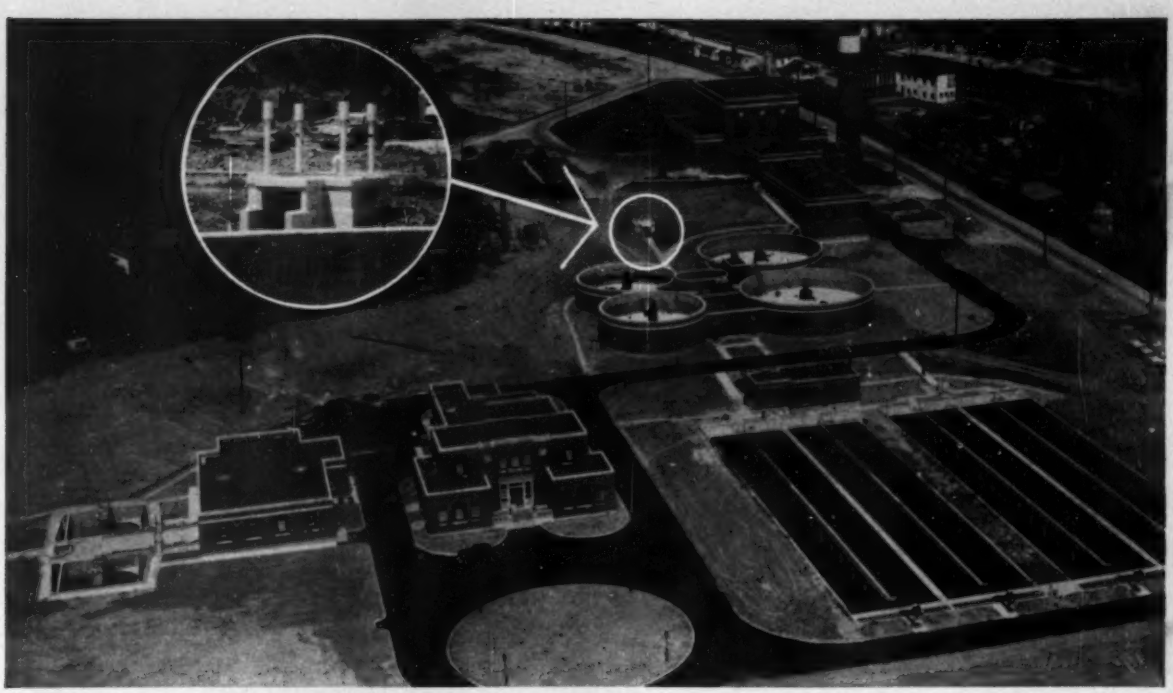
HAGAN HALL BUROMIN CALGON

CALGON inc.

A SUBSIDIARY OF HAGAN CORPORATION

HAGAN BUILDING, PITTSBURGH 30, PA.

*Calgon is the registered trade mark of Calgon, Inc. for its vitreous phosphate products.
†Licensed under U.S. Pat. No. 2,337,856.



At Arlington County, Virginia . . .

capacity increased—operations simplified

WITH P.F.T. FLOATING COVERS

In 1953, fast growing Arlington County expanded its capacity in a *practical* way by:

(1) converting its two 50′ tanks to secondary digestors
(2) adding two 65′ tanks for primary digestion
(3) equipping all four with P.F.T. Floating Covers

The result: P.F.T. "Controlled Digestion" and a new capacity of 20,000,000 gallons per day— 4 times the capacity of its former design!

Now, in addition to increased capacity, plant procedures are *simplified* because additions and withdrawals of sludge and digestor liquor can be made independently, *at the operator's convenience.* Floating Covers simply rise or lower with additions and withdrawals—*no fixed level need be maintained.*

P.F.T. Floating Covers also reduce costly breakdowns and repairs by eliminating all moving parts inside the digestor.

With its new equipment, Arlington soon found its gas production exceeding all requirements. This excess gas is safely handled by P.F.T. gas control equipment, including four 3″ waste gas burners mounted on a separate structure as shown in the illustration above.

As an added feature of this "Controlled Digestion", each tank contains a P.F.T. Supernatant Liquor Selector for automatic, continuous withdrawal of the best digestor liquor available.

Complete information on request—write for bulletin 332.

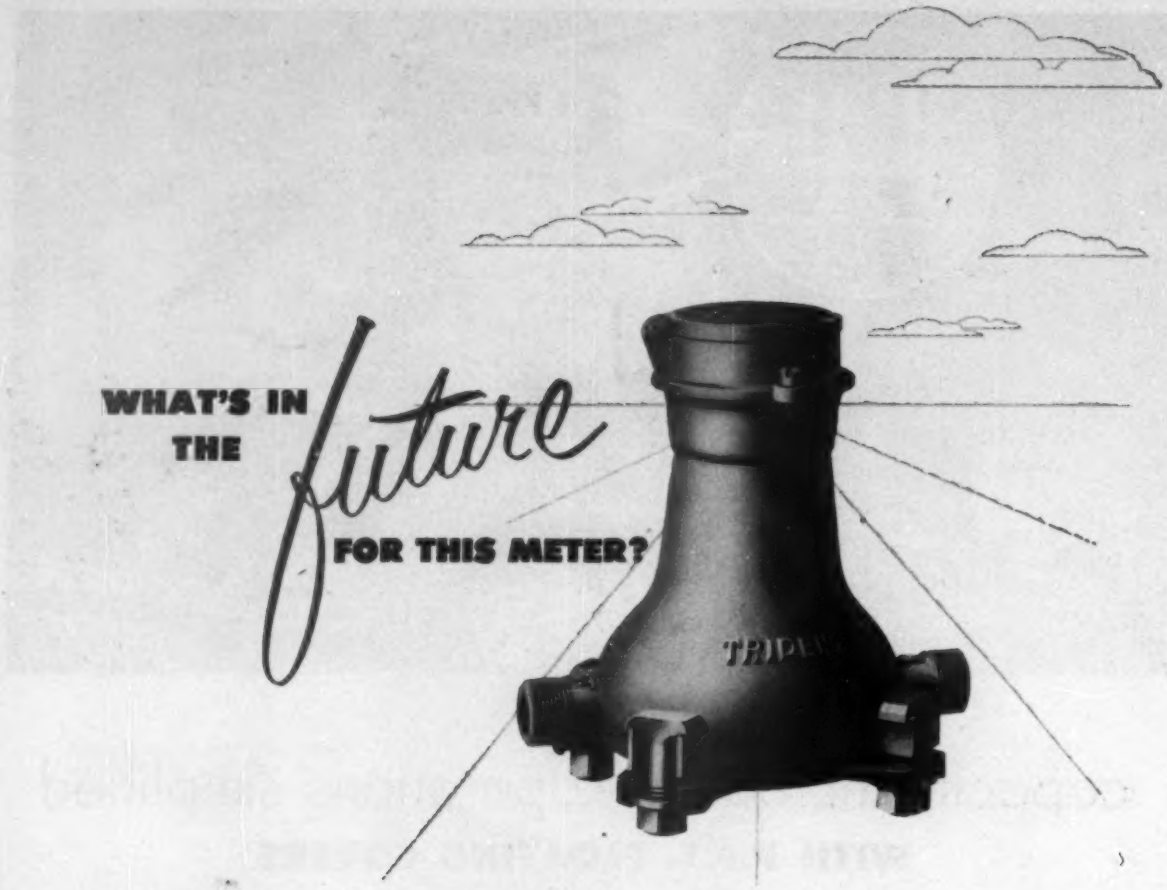
Design of plant by / *Alexander Potter Associates, New York, New York*

P.F.T.

waste treatment equipment exclusively since 1893

PACIFIC FLUSH TANK CO.
4241 Ravenswood Avenue
Chicago 13, Illinois

NEW YORK • LOS ANGELES • SAN FRANCISCO • CHARLOTTE, N. C. • JACKSONVILLE • DENVER



Just how good a meter will it be a quarter of a century from now? Will it be able to meet the standards of 1980 . . . or will later and improved models have made it obsolete?

Neptune's past record can help you answer these questions. During the past 50 years, more Trident meters have been purchased than any other make. Many of the oldest are still in operation.

More important, even these very old meters can almost match the performance of the one shown above. Because the newest Trident parts fit the oldest meters, Tridents are modernized every time they are repaired.

This 50-year record is your promise for the future. Your assurance that the Tridents you buy today will be assets for your community for years and years to come.

NEPTUNE METER COMPANY
50 West 50th Street • New York 20, N. Y.

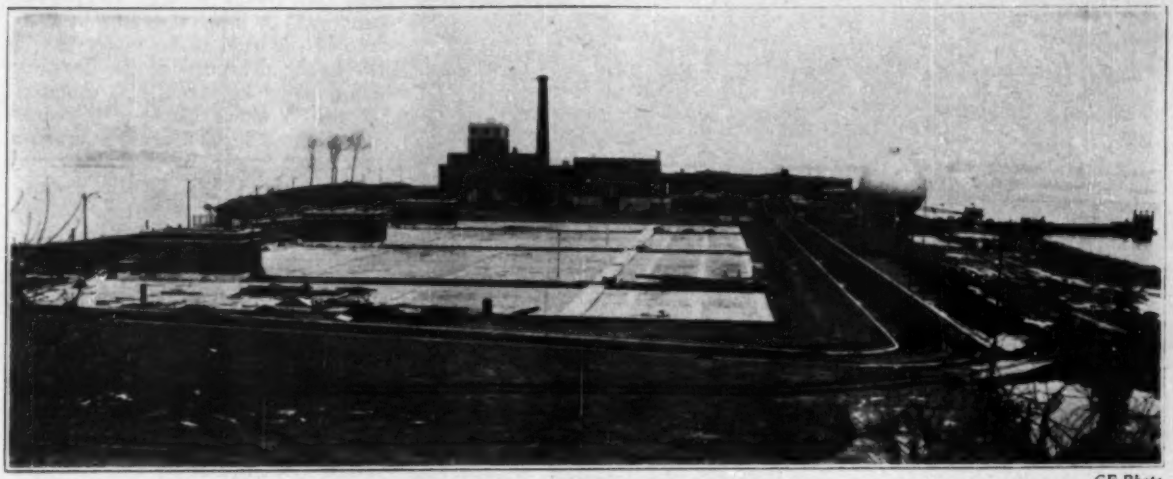
NEPTUNE METERS, LTD.
1430 Lakeshore Road • Toronto 14, Ontario

Branch Offices in Principal American and Canadian Cities

neptune

WATER & SEWAGE WORKS

VOL. 101, NO. 2 • • FEBRUARY 1954



BOSTON'S Nut Island sewage plant at Quincy, Mass., discharges effluent to Boston harbor *GE Photo*

Sewage and Industrial Waste Developments During 1953

A Review of the Year's Problems, Progress, and Research

by **DR. F. W. MOHLMAN,** ***Director of Labs., The Sanitary District of Chicago Chicago, Illinois***

A BRIEF contemplation of the developments in sewage and waste disposal during 1953 might lead one to conclude that it was a rather sterile and stationary year, devoid of progress in research or treatment. More thoughtful consideration leads one to conclude that it was just the reverse—a year of new ideas, new procedures and new accomplishments in old processes, now modified and accelerated to present a stimulating picture for the research or consulting practitioner in this field. This inevitable disclosure of new fields is what makes sewage and waste disposal so attractive and fascinating a field to the sanitarian, whether he be a chemist, a bacteriologist, an engineer or an executive in charge of treatment works. So let us ask and answer the question: "What is new?"

Probably the outstanding development of the year was the proposed acceleration of sludge digestion, which intrigued the interest and fancy of various equipment companies, competing for equipment sales in the disposal field, all hoping for the leading role in the field.

Possibilities in Accelerating Sludge Digestion

Digestion has long been a rather expensive and tedious process because of the time, temperature and volume required to stabilize organic matter in sludge, to change its dewatering properties, and to discharge an odorless product. To improve present practice requires:

(1) Initial thickening of sludge
(2) Increased temperature of digestion
(3) Intimate mechanical mixing of sludge

Thick sludge (8 to 10 per cent solids) should digest as well as more dilute sludge, so the first step is to concentrate raw sludge by flotation, as in a Bulkley-Dunton or Gibbs unit. This has been proven possible by more widespread use of these devices. Kraus some time ago developed the idea, it has been proven on various wastes and the remarkable saving in digester capacity can be easily visualized. Philip Morgan worked on the idea at Iowa University, it was demonstrated by Blodgett at Columbus, and equipment now is marketed by the Chicago Pump Company.

Loading rates of 0.345 lb. volatile solids per day per cu. ft. of digester volume have been demonstrated; the required period is 7 days, and well stabilized sludge is produced. The process is called "catalytic reduction," though using the magic adjective hardly seems necessary. However, the process digested 3.4 times as much sludge as was pro-

In France—O.F.T.A. process at the City of Paris Colombes sewage plant

duced in a parallel tank, with no concentration of raw sludge.

Torpey has experimented in New York and talks about 11 per cent raw sludge (containing no activated); Fischer stresses the use of a high-capacity propeller and draft tube for adequate mixing. Dorr calls its setup "Multidigestion."

Process Installations Must Provide Answers

Also much publicity has accrued to the Coors Plant at Golden, Colo., where digestion is applied at 135°F, in the thermophilic range, by use of a well-insulated tank that will maintain this temperature without undue loss of heat. Note that this plant includes ideas that have long been dormant; namely, sludge concentration, thermophilic digestion, enough insulation and normal gas production.

One may ask—what about odors in the discharged sludge? Laboon has succeeded in showing that the 5-day period of digestion will produce a dewaterable sludge but still seems concerned about odor. Does the sludge need a period of mesophilic digestion after the thermophilic, in order to eliminate odors and give a drainable sludge?

These and other questions remain to be answered, but the new ideas are intriguing enough to give confidence that answers must be forthcoming. Will we have short, hot digestion; insulation at reasonable expense; a sludge that requires no pre-treatment chemicals for vacuum filtration; a well-stirred sludge using the autogenous gases for admixture; and an odorless discharge sludge, concentrated and compact? If so, sewage treatment has taken a definite stride forward in 1953.

These developments high-lighted the October FSIWA Meeting at Miami and will set the pace for future progress. May we hope the early promises will be fulfilled! Laboon and Flood feel confident the Pittsburgh sludge will require no coagulants before vacuum filtration and visualize tremendous saving by the use of the 5-day (or less) digestion period. This hope, if realized, seems to me to be the outstanding development in 1953.

Composting Digested Sludge

In the effort to develop utilization of digested sludge for soil conditioning, extensive efforts were made in 1953 to reawaken interest in the composting processes at one time promoted by Beccari, Earp-Thomas, Frazer, Verdier, and others.

In America, Eweson reported the use of cultures and controlled aeration plus limited water content, to promote heating, disinfection and drying. Gotaas has discussed at length the economics of the process and has hopes it may be proven practical. A large operator in Buffalo is reported to be interested in the financial aspects of the development, which apparently is a sequel of the "Golden Garbage" process investigated in California a year or two ago.

In Scotland, J. C. Wylie, County Engineer for the Dumfries County Council, has reported on the production of a small amount of compost (40 tons per year) from the sludge of 4,000 people; his process is acclaimed by some associates, but not by the more experienced British sanitary engineers.

In Holland, large amounts of sludge are composted and the product sold, but at a modest price which does not show a profit. The old Indore process in India has had some followers (including Dr. Fowler) but has not developed into anything of particular interest. In New Zealand, composting has been fairly common, and the original bacteria promoted by Earp-Thomas were reported to be native to this antipodean community.

Thus we see the widespread ramifications of composting, and its main factor of truth which, when crushed to earth, again rises in a new form. The truth survives like the fabulous salamander.

Secondary Treatment Processes

The next most important field of development, in 1953, was the attention given to modifications of ac-

Chicago, Ill.—The Southwest works produces 400 dry tons of sludge per day

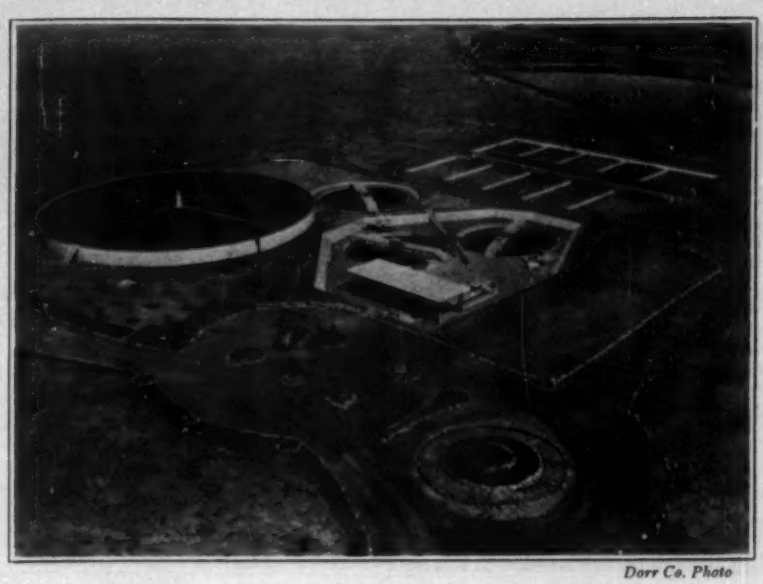
tivated sludge and trickling filters, and to more critical evaluation of aeration, mechanical activation, recirculation and filter loading.

Activated sludge has had much study, although the large, new plants have not as yet incorporated the modifications studied on a small scale. The Los Angeles plant still operates with limited or no sludge return, but the detergent problem there seems to be licked and satisfactory effluents are discharged. Some difficulties are reported in the sale of dried sludge; but the limited air supply seems to be the major problem, in view of the strong sewage and the deficient dissolved oxygen available.

Air Diffusion Methods

The question of the most efficient method of applying air is still subject to study. The standard diffused-air aeration procedure is attacked from several angles—differences in aerating devices, and improvements in mechanical or other methods of applying oxygen. Standard practice maintains that the air be finely divided by discharge through porous diffuser plates, relying on the absorption from the rising bubbles. Thus, the finer the bubbles, within limits of cost, the more efficient the aeration.

However, a minor faction holds that the air can be applied in large bubbles, provided the surface velocity is at a maximum for a given amount of air, in which case absorption from the surface of the tank is held to be more important than from the surface of the bubbles. Dr. Popel, of Stuttgart, is the major advocate of this thesis, and he has won some disciples in England, where Col. Hill, of the Ministry of Health, is impressed by Popel's work.



Dorr Co. Photo

In South Africa—Single stage Biofiltration plant at Town of Venterspost

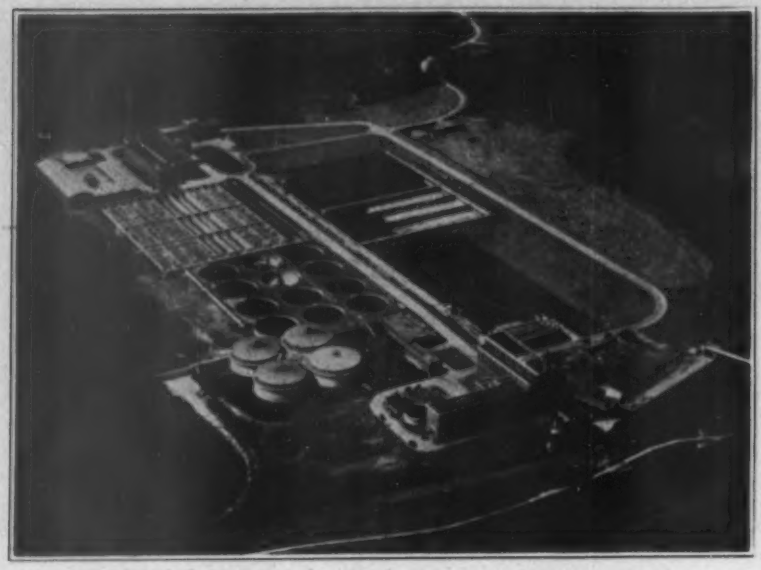
This work has led to the design of aeration tanks by Popel at Heilbronn, in which air is applied through open pipes about one-fourth to one-half inch in diameter, and bifurcated circulation occurs in a double-barrelled tank with sloping sides. This idea also appeals to Drs. Kessener and Pasveer in Holland and has been used for some years at the Acheres plant in Paris, which Popel claims is more efficient than air-diffusion plants in England and the United States.

The Acheres plant has accumulated only limited operating data and analyses. This plant was not particularly impressive as to efficiency when the writer visited it in 1948, and he so reported in his review for that year. The plant at Colombes is much smaller than the Acheres plant. It seems unlikely that British or American plants will be modified in design of air application by this research.

The mechanical aerators, such as the Simplex or Haworth's Sheffield paddles (also Kessener's brushes), have been improved by more efficient design and application of mechanical parts; the claim is made that they can compete with diffused-air aeration, and one must concede the improvements are well substantiated. But here again the large plants (at least in the U.S.) probably will not follow any new design for aeration tanks.

These advances, however, further the cause of mechanical aeration and warrant more investigation. In addition, recirculation is proven practice in high-rate filters and, for some wastes, even up to 5 to 1 is recom-

Vacuum filters in Chicago's Southwest works are 14 ft. by 11 ft. diam. Left 56 units, right 42 units



In England—New Maple Lodge works activated sludge treatment plant

mended in order to increase the loading and to dilute the waste.

Activated Sludge Developments

The outstanding development at Chicago has been the initial operation in 1953 of added vacuum filters (increased from 32 to 98) and the production of some 400 tons per day of dried sludge, all sold as fertilizer. The West-Southwest Treatment Works treated an average of more than 800 mgd in 1935, and reached capacity in sludge handling toward the close of the year. Previously, about one-third to one-half of the sludge was lagooned, undigested; these lagoons will be supplanted next year by filters and flash-drying.

Chicago and Milwaukee are interested in the possibilities of using the B12 in activated sludge for stock feed. For several years Chicago has supported a research program at the University of Illinois, planned to utilize the dry activated sludge *as is* for feeds. The sludge is rich enough in this vitamin to give an adequate dose without concentrating.

Milwaukee, however, has been studying the extraction of B12 from activated sludge and still is carrying on pilot-plant work toward that end. It is hoped that private capital will build a plant, costing about one million dollars, for this extraction. Both cities are convinced of the value of their sludge, up to certain percentages, as a stimulant. It appears to be suitable for pig feed, up to two or three months of age; for chicken feed; and for other non-human nutritional uses.

New York has completed the Rockaway and Oakwood activated sludge plants. These are to use a process called "modified aeration," giving reductions of 80 per cent of suspended solids, and about 75 per cent of the B.O.D.

Some interest developed in 1953 with reference to sludge recovery, as fertilizer, at the Indianapolis plant, but no remodelling has been completed.

The Baltimore enlargements include a two million dollar sludge drying plant, in operation in 1953.

Chicago and New York results of operation were discussed by Anderson and Gould at the October, 1953, meeting of the American Society of Civil Engineers. Most complete data are available in their papers, showing a rather high degree of treatment in Chicago and at Ward's Island, and a lower quality for the modified aeration at the other plants. The advantages of "step aeration" are demonstrated at Ward's Island and Hunt's Point.

The Southerly Treatment Works at Cleveland has been rebuilt as an activated sludge plant, with abandonment of the trickling filters, largely disintegrated.

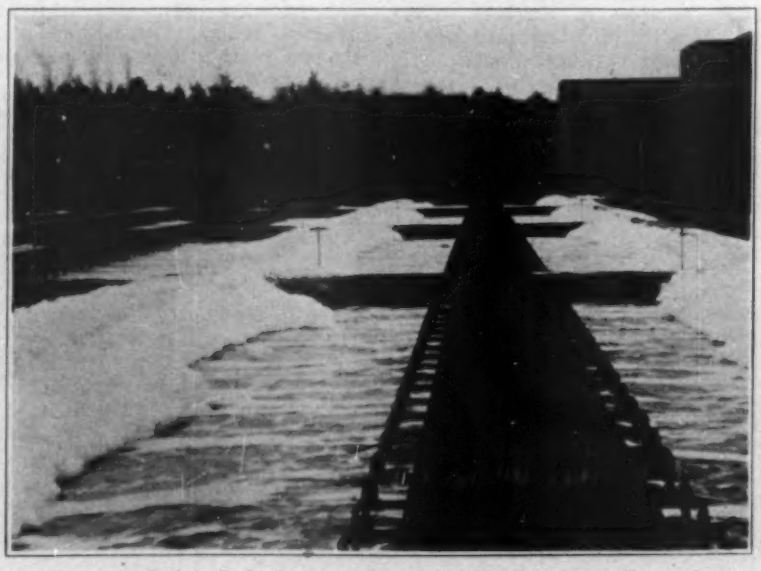
The Miami treatment works, a $27 million project, is to utilize modified aeration, with discharge of effluent into 18 ft. of water through an outfall 4600 ft. long.

On the whole, activated sludge treatment is selected for large plants in preference to trickling filters—although the latter, operating at high rates, seem preferred for treating more toxic industrial wastes.

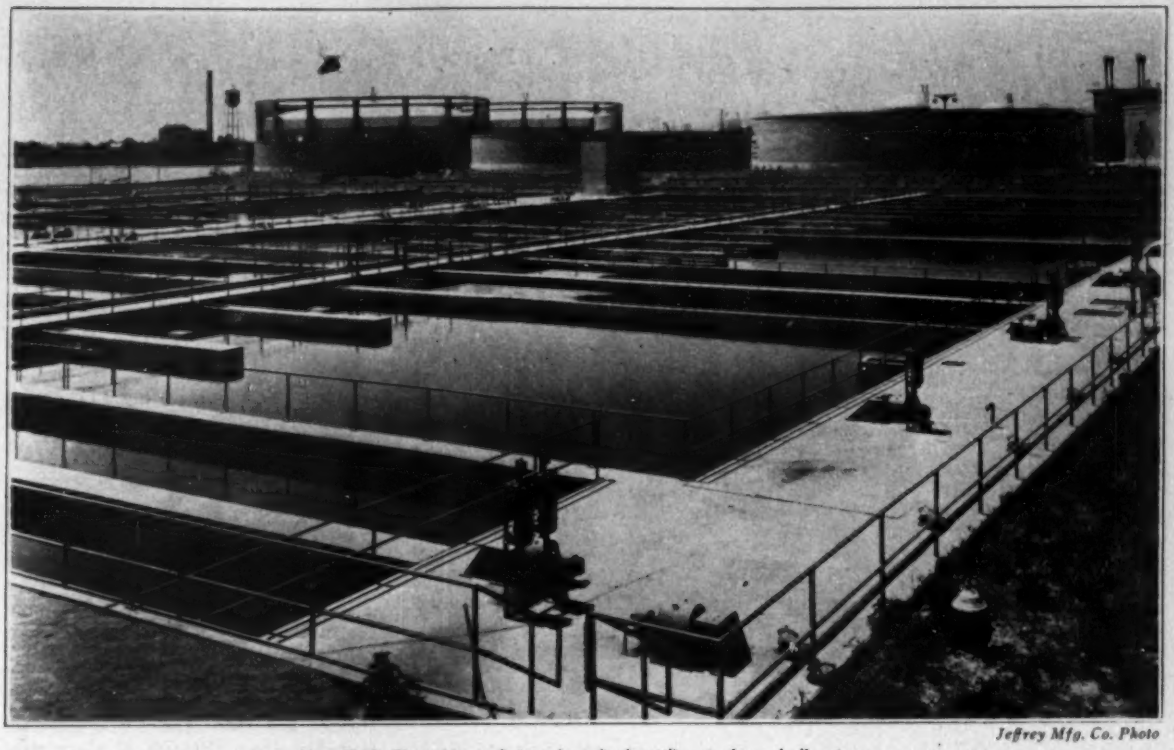
Primary Treatment Installations

While primary treatment was selected for many projects, the trend in 1953 was toward sedimentation with chemicals, and the use of preaeration or mechanical flocculation. Among the more important plants of this type are the following:

Cincinnati started its Little Miami plant in 1953; began collecting sewer rentals for the much larger Mill Creek Plant; and broke ground for the latter plant in a two-state rally last October sixth. The Mill Creek plant is expected to receive approximately the strongest sewage of any large city in the United States, particularly because of the discharge from Procter and Gamble and other industries. Considerable surcharges are made, however, for



Detergents froth in England too—condition at the Mogden plant is illustrated



Jeffrey Mfg. Co. Photo

New York City—Hunts Point plant final settling tanks and digesters

industrial wastes and concentrations over 500 ppm suspended solids or 400 B.O.D. are prohibited. The limits of normal sewage are set at 300 ppm suspended solids and 240 B.O.D. Chemicals are to be used part of the year, for producing a better effluent. A most elaborate sewer rental schedule is authorized.

Pittsburgh faces a $60 million project for Allegheny County; part of the intercepting system has been completed, but the treatment plant has not been started. Pilot plant work has developed the sludge concentration and filtration system based on the type promoted by Laboon.

Denver is enlarging its primary treatment plant, adding 30 minutes of aeration, and will operate with or without chemicals.

Portland has started operation of its new primary treatment plant. The sludge is digested and is discharged into the Columbia River. This procedure seems warranted because of the large dilution, and was adopted after careful attention was given to this novel disposal project by A. M. Rawn.

Camden, N.J., is building a new plant along the Delaware, hoped to be in operation in 1954. This primary treatment works will receive waste from the Campbell Soup Company and R.C.A., as well as many other industries. Sewer rentals have been collected for several years.

Schenectady, home of Morris Cohen, is rehabilitating its primary treatment works. The city expects to dry sludge and sell it as "Orgro" —some 1,000 bags (80 lb. each) each week, and up to 1,300 bags in 1970. This project will awaken interest.

Wilmington, N.C., Charleston, W. Va., and Nashville, and Knoxville, Tenn., are building multi-million dollar primary plants.

A multi-million dollar sewage project at Richmond, Va., and a modified activated sludge plant for the District of Columbia are under design by Greeley and Hansen.

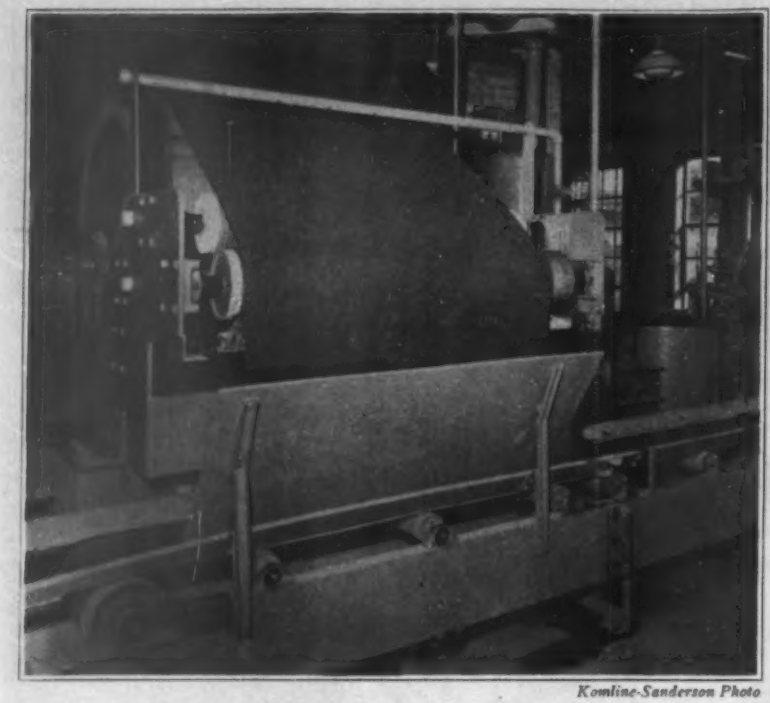
Large Size Regional Projects

The Pittsburgh project leads the field of expensive sewage treatment projects, followed by the Miami plant, still in the stages of planning, and by the Middlesex County ($25 million) and Somerset County ($7.5 million) in New Jersey.

The latter two projects have been on the firing line for the past 20 years, first as an overall $32 million project, but now as the split Raritan River cleanup, because of the withdrawal of the Somerset County group from the downstream district. The Calco Chemical Co. and Johns-Manville Co. are the dissenters to the overall project, as they believe they can better go it alone. The downstream plan is well under way, with the sewer work assigned to Elson Killam and Charles Kupper, and the treatment plant and overall design handled by Metcalf and Eddy. The Somerset faction has a report by Sheppard Powell and Charles Requardt now under consideration, and is making a pilot plant study. Effluent is to be discharged into the Raritan River, Raritan Bay and thence into Lower New York Bay; the degree of treatment is planned to meet standards of the Interstate Sanitation District.

The Niagara Frontier has been a concern of the New York State Department of Health and the Stream Pollution Authority for some years, with consideration to further sewage disposal progress. The Buffalo treatment works is a primary treatment plant, with adequate chlorination. However, the question of tastes and odors in downstream water supplies (the Tonawandas and Lewiston) calls attention to industrial waste discharge containing phenol or other taste-producing chemicals; thus the New York authorities are required to classify the Niagara and Buffalo Rivers with reference to the discharge of industrial and municipal wastes.

In a hearing in Buffalo October 21, 1953, arguments were presented



Komline-Sanderson Photo

St. Charles, Ill.—Coilfilter in use to dewater fresh sewage solids

for and against certain classifications tentatively adopted. The Niagara classification (Class C) was considered almost too liberal, in view of the necessary reduction of phenol, while the Buffalo River (Class D) was considered too stringent, in view of the industrial utilization of this river and the unreasonable cost of treating wastes to permit maintaining dissolved oxygen in this river up to 3.0 ppm, a rather astonishing and unnecessary requirement.

This Niagara problem also affects the future of the International Joint Commission on Boundary Waters, which has had the technical aid of the U. S. Public Health Service, the New York State Dept. of Health, and the Ontario sanitary authorities. It is an outstanding international problem. The Detroit area also is subject to the I.J.C. standards, and is trying to meet the requirements by municipal and industrial cleanups.

The Ohio River problem is handled by Mr. Cleary's organization, ORSANCO, with adequate control and publicity. The entire stream has been classified as to degree of municipal and industrial requirements and some nine industrial-waste committees, with a total of 160 members, are busily engaged in drawing up manuals on methods of treating wastes in their own industries. These include metal finishing, steel pickling wastes, phenol, brine, electroplating, organic chemicals, oil refineries, chemical salts, distilleries and coal mining wastes. These reports have been satisfactory to the Commission, so much so that Mr. Cleary states "There has been a lot of action, so much, in fact, that in some respects the task to which the efforts of the Commission have been dedicated has reached the halfway point to completion." This progress must be very gratifying to the various states contributary to ORSANCO.

The Missouri River is comparatively unaffected by the national drive for stream purification, but the large sources of pollution from sugar-beet wastes, packinghouse and stockyards wastes, and chemical wastes are testing the assimilative capacity even of this behemoth of rivers, especially when its flow wanes late in the summer.

Other large rivers such as the Columbia, Mississippi and Delaware have problems similar to those of the Ohio, but their critical conditions are less imminent. The Delaware, however, is in the throes of litigation between conflicting interests.

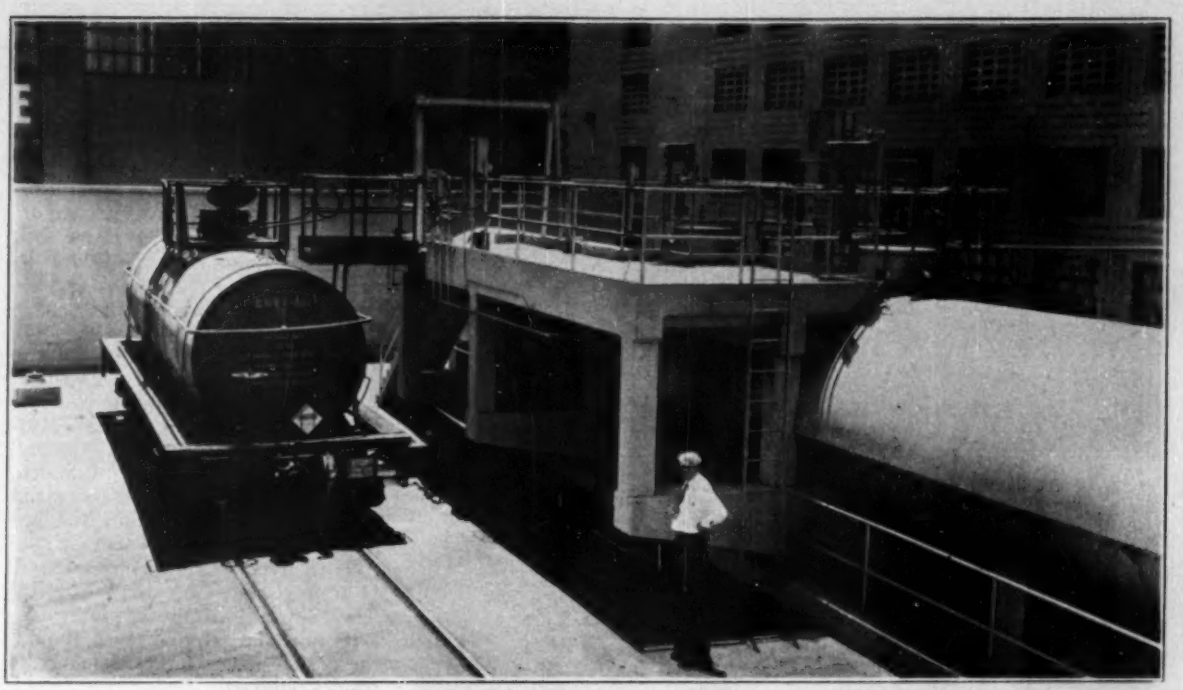
Foreign Sewage Problems

Pollution of the Rhine has reached proportions, due principally to phenolic wastes, such that action by a broadly constituted committee is required. One has been set up, headed by Prof. Jaag of Zurich, for supervisory control over the discharge of industrial wastes. The wastes are from the Ruhr District and Emscher District in Germany, from chemical plants in Basel, Switzerland, and from Strasbourg and other intermediate points.

The problem of greatest interest in the British Isles centers in the Colne Valley, above London, where the new $18 million Maple Lodge activated sludge plant has been operated by W. Fillingham Brown since its start in 1951. When visited in November, 1952, it was in complete operation. The activated sludge solids had built up to 10,000 ppm in the aeration tanks, due to inability

Am. Well Works Photo

Bristol, Tenn.—The Bristol, Tenn.-Va. plant completed in 1953



San Francisco, Calif.—Bulk storage of liquid chlorine in two 50-ton tanks at the North Point sewage plant

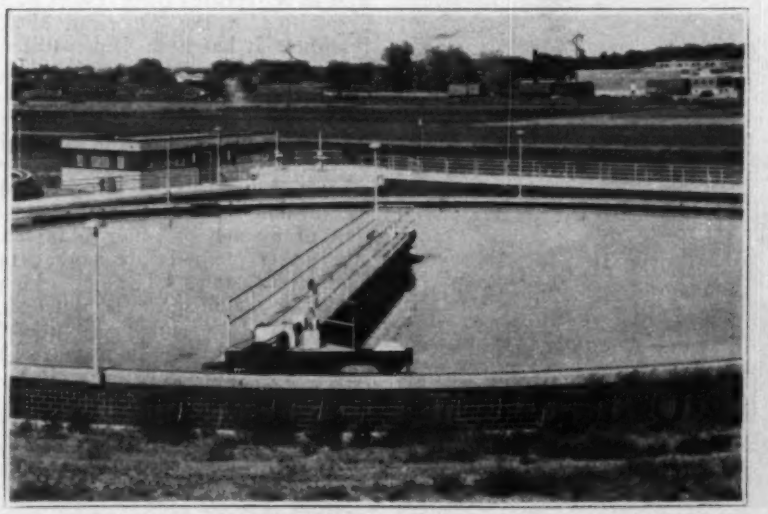
to filter the sludge after its elutriation, and after conditioning with chlorinated copperas and lime. It is hoped these difficulties have been eliminated in the year 1953, as the plant otherwise is impressive; it is next in size to the Mogden Plant, and contains the largest mechanical sludge drying plant outside the United States.

Egypt has a sewage disposal problem at Alexandria, the summer resort and residential suburb of Cairo. The sewage at present discharges into the Mediterranean Sea and projects are under consideration to extend the outfall sewer protection of the extensive bathing beaches. However, it is a minority belief that an activated sludge effluent could be disposed of in lakes landward from Alexandria, with more assurance of safe beaches; these conflicting views must be reconciled.

A large sewage disposal project is under active consideration at Brazil's wonder city, Sao Paulo, the "Chicago of Brazil." A report has been submitted concerning this, after study by the firm of Greeley and Hansen, concluding that the city, and metropolitan area with a total population estimated as 3,570,000 in 1975, should be divided into six sewage treatment districts; for treatment, one or two-stage filters or mechanical aeration would be required.

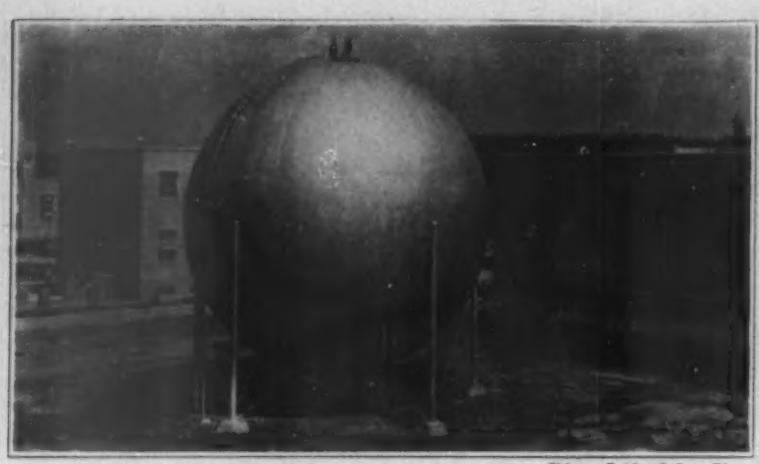
Project plans and specifications for the first of the six treatment plants, which will serve 970,000 people were included in the report. Filters are preferred, under Brazilian conditions. The industrial wastes are innumerable (mostly textile, food products, packinghouses, dairies, drugs and chemicals, pulp and paper and miscellaneous), with a total population equivalent of 880,000—considerably below Chicago's industrial waste load.

A large project is under way at Auckland, New Zealand, for disposal of the city sewage and a concentration of packinghouse wastes on a scale second only to that of Chicago. The total project was estimated to cost 5.4 million pounds ($15.1 million), but the authorities restricted the project to treatment without including the packinghouse wastes. This seems rather inadequate as the human population is 369,000 and the packinghouse waste 313,000, both on the basis of flow and B.O.D. The decision to eliminate packinghouse wastes elicited a strong protest from the so-called Auckland and Suburban Drainage League; however, at last reports only the restricted project was under way.



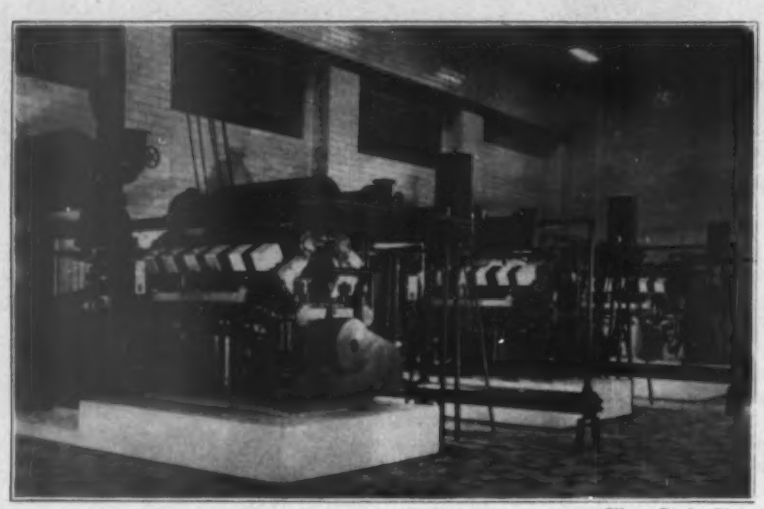
Link-Belt Co. Photo

Denver, Colo.—Circuline sludge collectors in one of two 150-ft. clarifiers



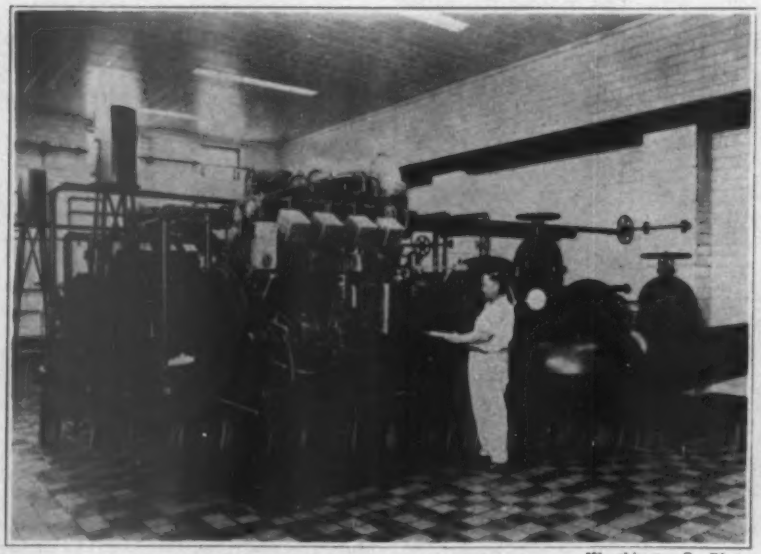
Chicago Bridge & Iron Photo

Cincinnati, Ohio—Sludge gas storage in 36-ft. diam. Hortonsphere



Climax Engine Photo

Roanoke, Va.—Three 220 H.P. sludge gas engines drive air blowers



Worthington Co. Photo

Roanoke, Va.—Two 134 H.P. sludge gas engines drive 12 mgd pumps

A final glance at foreign problems calls attention to the challenge facing the firm of Metcalf and Eddy in connection with sanitary works for the new air bases in Spain. Sites have been selected at San Sebastian, Madrid, Barcelona, Valencia, Gibraltar and Seville. It will be difficult to think of Seville, the pearl of Andalusia, as a military base, but indolent Spain is waking up to modern life and the Feria may become even more hectic.

The Industrial Wastes Field

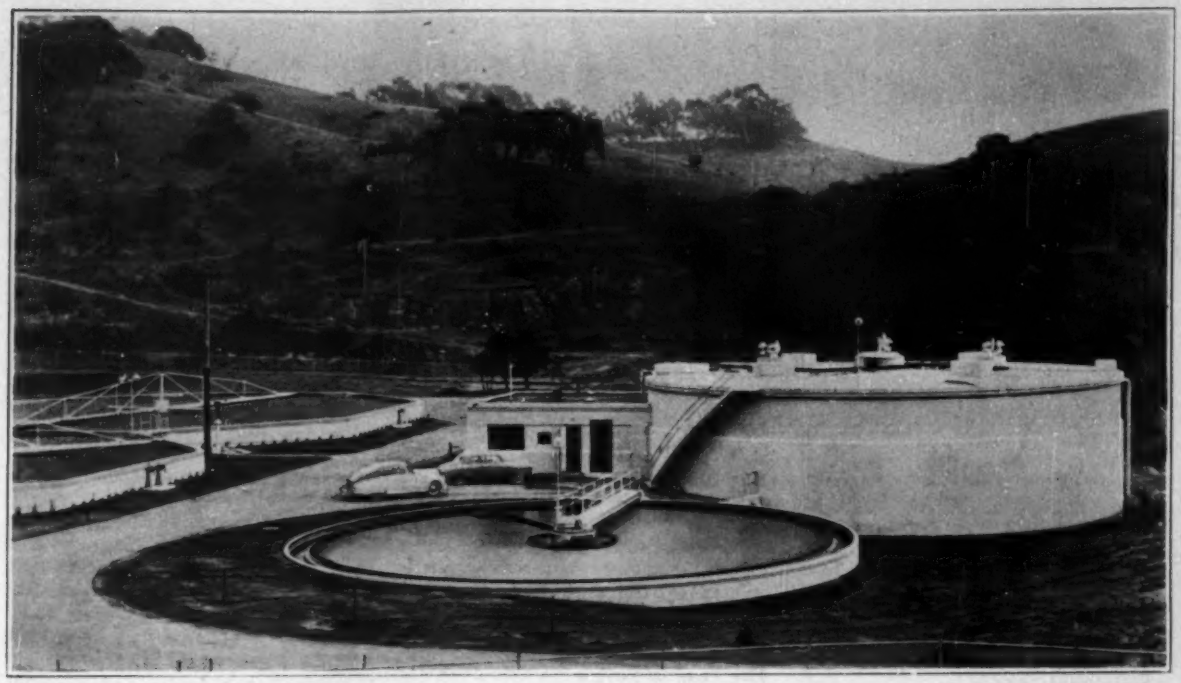
The importance of industrial wastes in the large projects just discussed is evident. At Buffalo, Middlesex County, Somerset County, Pittsburgh, Cincinnati, Camden, Omaha, and Auckland, industrial wastes almost overshadow the human waste problem, or at least control the type of treatment selected. If toxic wastes threaten biological processes, sedimentation plus chemicals must be selected, even though the cost is out of proportion to the results obtained.

Beyond the joint or regional problems, industry must face treatment for isolated factories, and under such conditions the problems are really tough. There is no doubt that industry is quite interested in research on waste disposal, and in some cases full-scale plants are being built as the result of research.

Consider the packinghouse industry. Many packinghouse plants now are in operation, usually as adjuncts of municipal sewage treatment works. However, the rapid anaerobic fermentation originally studied by Fullen and Murphy has been more exhaustively investigated by Schroepfer, Fullen and Anderson, who have reported their results to a Committee of the American Meat Institute. It has been demonstrated that anaerobic digestion for less than 24 hours at 95° F, is sufficient, with recirculation of 200 to 300 per cent. The major problem, removal of floating suspended solids in the effluent, apparently has been solved by vacuum separation, or by addition of fly ash or other additives. Also other methods are suggested. The report states "The one which comes to mind now is flotation, which may have some possibilities." It is suggested that this problem be investigated more fully.

This process of anaerobic digestion seems quite applicable to other types of organic wastes, such as brewery, formaldehyde, food products, or fermentation processes.

However, the treatment of antibiotic wastes, such as penicillin,



Dorr Co. Photo

San Marin County, Calif.—Sanitary District No. 1, a Biofiltration plant serves five communities within the District and two towns by service agreement

aueromycin, streptomycin, and erythromycin has rather generally followed aerobic processes: either using trickling filters, as at Lederle, Upjohn or Merck, or activated sludge, now being installed by Abbott. Very extensive pilot-plant studies for Heyden have been reported by Rudolfs and Muss, but no large-scale plant has been constructed. Many other research studies on industrial wastes were reported in 1953.

Iron recovery from pickling liquors is operated on a plant scale by the International Harvester Company in Chicago. Bulkley-Dunton colloiders are being installed in several plants in Chicago, for flotation and removal of mineral oil.

The various chlorine and chlorine dioxide processes for destruction of phenol have not had much development because of the operating expense involved.

Volatile compounds can be destroyed, if in sufficient concentration, by the catalytic oxidation process developed by DuPont, under British Patent Specification 694,458 published July 22, 1953. This process had wide publicity when first proposed, but has not enjoyed much use. Its future possibilities are of interest.

Sulfite pulp waste problems are yielding to the alcohol recovery process and to the torula fodder yeast process, as well as to the alternate evaporator scheme; Murdock is encouraged to predict that, in another decade, "modern methods and well-designed equipment will have reduced stream pollution from the pulp and paper industry to a matter of little importance." This should be good news to Dr. Gehm.

Detergents are a troublesome problem in England largely because the former profits from recovery of grease at Bradford have been eliminated by substitution of detergents for soap. The British Ministry of Health is concerned about the pollution of rivers, foaming at treatment works, and other detergent problems. Also, the difficulties at the Mogden works have induced Mr. Townend to plan to visit the U. S. next April, to survey the detergent problem here.

In America, much work on detergents has been under way for several years at Procter and Gamble, M.I.T., and Harvard. Recently Culp and Stoltenberg in Kansas, reported considerable operating difficulties under conditions of low dilution in the Marais des Cygnes River at Osawatomie. These difficulties did not occur unless synthetic detergent concentrations exceeded 3.9 ppm in the river water, a rather high concentration. The detergent problem seems no nearer to elimination.

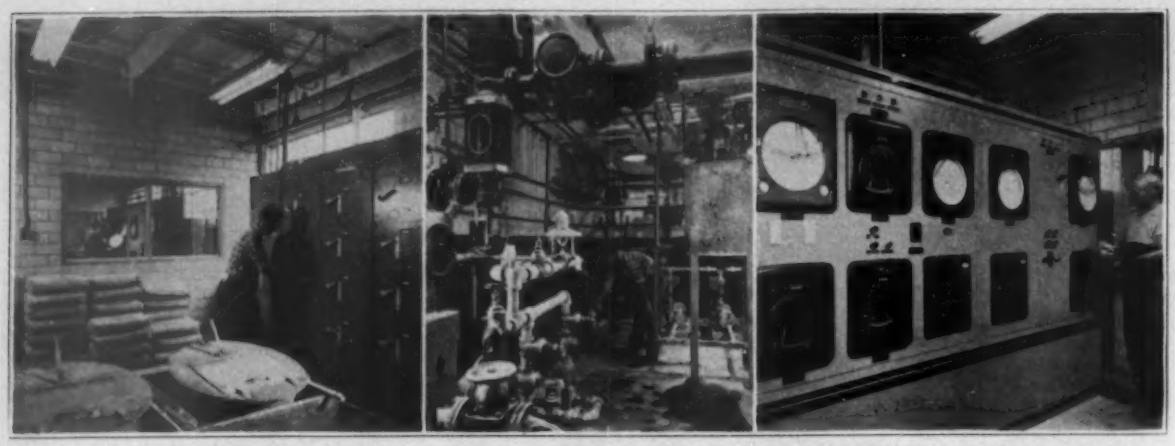
Atomic Energy Industry Wastes

Wastes from the atomic energy industry are not feared as much as they were several years ago, because of the attention given to them by the Atomic Energy Commission and the U. S. Public Health Service. Arthur Gorman is in-charge of this work and he has recently stated that incineration, land burial and sea disposal are adequately taking care of any dangerous wastes from present installations. However, sea disposal is considered to have serious disadvantages, and incineration requires costly air-cleaning facilities. Evaporation is expensive, and the storage of ash or long half-period liquid wastes requires isolation and supervision of such areas, probably for generations of time.

Those wastes having a high level of activity but a short half-life are stored long enough to reduce emanations to reasonable levels. The activity of long half-life residues is still the major problem. It must be conceded that waste disposal in the atomic energy field is still an unsolved problem, although not a dangerous hazard under present conditions.

Back To Septic Tanks

It is rather a long step from multi-million-dollar sewage treatment plants down to septic tanks of a few hundred gallons capacity, but



Westinghouse Electric Photo

Sharon, Pa.—Industrial waste treatment plant. Left, instrument room in background and control center in foreground. Center, pump room; acid pipes and cyanide pipes are color-coded. Right, close-up of the control board.

the latter are receiving much attention. The Third European Symposium for Sanitary Engineers met in London, in 1952, under the auspices of the World Health Organization, and discussed European septic tank practices. There were engineers representing 20 countries present at the meeting, including Scotland, Ireland, Wales, Iceland, Finland, Yugoslavia and other European countries, not including Russia. The meeting was arranged by Renato Pavanello, a former University of Michigan graduate student, who has been in the Geneva office of the W.H.O. for some years.

The results of the meeting have been published by the W.H.O. in a 122-page monograph, No. 18, sold for $1.50 by the Columbia University Press, 2960 Broadway, New York. The data present the European viewpoint, with very little reference to U. S. standards set up by the extensive work of the U. S. Public Health Service.

The Year in Review

The variety of new ideas in 1953 was unprecedented, indicating that sewage disposal practice is far from being standardized or static. The major suggestions, research, and development, have been mentioned in this review—but, actually, the contributions of unmentioned engineers exceed those noted here, and there are many lines of development for the future.

It is unfortunate that two leaders of our field are no longer in our midst. Dr. Willem Rudolfs retired and went to The Netherlands, his old home, about a year ago, to live and enjoy his remaining years. We hope he will return occasionally to survey the scene of his life's work and to visit his many students and friends. Prof. Earle B. Phelps died last May, after living and working to a ripe old age in Florida. A testimonial foundation is being organized in his honor, so that he will not soon be forgotten.

We all must realize, however, that the world of our technology progresses quite well without us, and be happy that our young colleagues face the future as undiscouraged and vigorous as we did when we started. We only can say *Ave atque Vale*, as I wrote in an editorial when Earle Phelps re-entered the sanitary engineering field in October 1930, shortly after Kenneth Allen's death.

$64,600,000 Spent on Sewage Treatment in Second Quarter of 1953

Progress being made in stream pollution correction can no better be attested to than in the following report issued by the U.S. Public Health Service.

> "During the second quarter of 1953, municipalities awarded contracts for 204 projects to abate water pollution. The $64.6 million represented by these public sewage treatment plant projects was more than double the amount for the preceding quarter's contracts, and 55 per cent greater than that reported in the corresponding 1952 period. Of the 204 projects, 118 are new plants, costing $45.3 million, and 86 are additions, enlargements, or replacements, costing $19.3 million."

The U.S. Public Health Service compiled these figures from reports of state pollution control agencies, construction reports of the F. W. Dodge Corp. and other construction news sources.

By reliable sources it is predicted that in 1954 approximately 61% more will be spent on plants to relieve stream pollution than was spent in 1953. Looking ahead at "Construction in 1954" the news magazine *Newsweek* also predicts that the $761,000,000 spent for sewage and water supply projects in 1953 will increase by $64,000,000 to a total of $825,000,000 in this year of 1954.

Tax Relief in Sight for Industry Treating Wastes

There appears to be considerable certainty that legislation will be passed by the present Congress which is to encourage waste treatment by industry. Following the pattern set by Wisconsin, which passed an act (Chapter 183, Laws of 1953) exempting waste treatment facilities from local property taxes for 5 years and permits amortization of such facilities over a 5 year period for purpose of arriving at state income tax, the Congress will consider three bills (HR. 234; H.R. 606; H.R. 2535) designed to permit industry to amortize investment in waste curtailment or treatment facilities over a 5 year period instead of the present 20 year period for Federal Income Tax deductions.

In hearings by the House Ways & Means Committee many water pollution control agencies have appeared in favor of the relief bills and some form of relief to those with pollution correction problems seems assured.

SEWAGE WORKS PRACTICES

Imhoff Tank Operation

Seventh in a Series

by **DON E. BLOODGOOD,** ***Professor of Sanitary Engineering***
Purdue University, Lafayette, Ind.

In this series, Professor Bloodgood discusses *Sewage Works Practices* in the form of simple short course lectures. Each article is designed to interest and assist plant operators, students, and all who wish to review fundaments in this field.

The Editors

THE Imhoff tank was invented by the German sanitary engineer, Dr. Karl Imhoff, still living in his native land. It is apparent from the design and operation of these tanks that the inventor incorporated several fundamental ideas that made this unit superior to the septic tank. In the septic tank, sedimentation and solids decomposition take place in the same compartment. Engineer Imhoff apparently had made calculations showing that it was less expensive to build his combination unit than it was to build two separate tanks, one for sedimentation and one for sludge decomposition.

In the early years of this century, many septic tanks were installed to remove and hold for decomposition the settleable solids from municipal sewage. Frequent difficulties were encountered in the operation of early installations, and attempts were made to modify the design of these units to improve their operation.

There are a few installations of Imhoff tanks in large cities, such as the installations at Baltimore and the West Side Works of the Chicago Sanitary District. In recent years, however, there have been no installations in large cities; in fact, there have been very few Imhoff tanks constructed in recent years. One might well ask why any time should be spent in discussing the operation of this type of tank. The answer is that there are now in operation throughout the United States hundreds of Imhoff tanks that will be in use for many years to come.

Function of the Imhoff Tank

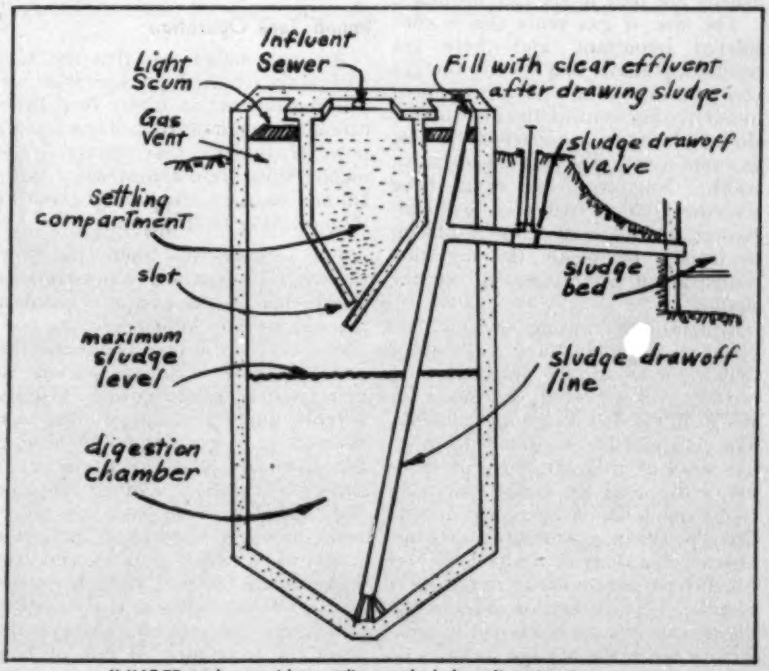
Septic tank operation has shown that digesting sewage solids (the sludge) tend to rise because of the gases being released. These solids mixed with the top layer of liquid leaving the septic tank—and, as a result, the tank effluent often was worse than the influent. The Imhoff tank was so designed that the solids settling from the sewage flowing through an upper section, entered a lower digestion compartment and were trapped there so that they could not be carried back into the settling compartment by the liberated gas.

The lower section was designed for digestion of the solids. Digestion of the solids results in a reduction in the quantity of organic material. Because some organic solids are converted to gas and water, there are fewer pounds of solids to be hauled away or otherwise disposed of; also, the solids remaining after digestion are much less obnoxious in odor characteristics than are raw sewage solids.

Types of Imhoff Tanks

The first illustration shows the design of one type of Imhoff tank. Many different designs have been employed, but all have incorporated the basic principle of the *two-story tank*. Engineers frequently have made changes in the relative size of the compartments, gas vents, slope of the bottom of the compartments, methods of sludge removal, etc.

Some standards of design at the present time specify a sedimentation



IMHOFF tank—provides settling and sludge digestion in one unit

SEWAGE treatment plant including Imhoff tanks, trickling filter and sludge drying beds
This compact installation serves a state hospital in Chester County, Pa.

compartment having a 2.5-hour detention period. A slope of the bottom of the settling compartment of 1.4 vertical to 1 horizontal is recommended. This slope is considered necessary in order to make sure that the settled solids will slide down the slope and fall through the slot into the sludge digestion compartment. The sludge slots usually are four to six inch openings.

The size of gas vents also is considered important, and there are recommendations that specify the gas vent openings to be equivalent in area to twenty per cent of the area of the sludge digestion compartment. The gas vent must be at least 24 inches in width. Narrower gas vents have sometimes been built; in such instances, plant operators find it difficult to inspect or repair the digestion compartment after pumping out the sludge.

It is desirable to have the inlet and outlet of an Imhoff tank so designed that the flow can be reversed, thus resulting in an even deposition of sludge in the digestion compartments. The sludge often is removed by gravity flow, as this arrangement eliminates the need for sludge pumping. Some standards of design recommend that the sludge compartment volume provide a capacity of 3 to 5 cubic feet for each person connected to the sewer system. This method of determining the necessary volume needed is satisfactory when the sewage includes no appreciable quantities of industrial wastes that contribute solids in considerable amounts.

Many Imhoff tanks now in use do not have effluent weirs. Such weirs, no doubt, would improve the removal of solids in the tanks; but to design them properly for tanks where reversal of flow is practiced is most difficult.

Imhoff Tank Operation

An early belief was that the Imhoff tank required no operation or maintenance or, at most, very little care and attention. It has been found, however, that the best sewage treatment results are obtained when careful and constant attention is given to the operation of these units.

For effective operation, the flow through the settling compartments should not be allowed to exceed a determined rate. When there is a possibility that storm flows can enter the plant, someone should be present to divert the excessive flows. If flows several times the design rate are allowed to pass through the settling compartments, there may be such turbulence that no settling can take place. If there is no secondary treatment following the Imhoff tank, this would mean that the sewage and rain water might as well have been bypassed. If an operator is on the job he could arrange to take through the plant the recommended rate of flow and there would be a satisfactory removal of solids from the sewage treated.

Storm water, in another instance, might be heavily loaded with clay and silt. Great quantities of that heavy material would settle out and add to the sewage solids in the digestion compartment a load that could not be decomposed; clay and silt, however, would not materially injure the receiving stream if they were discharged directly to it.

In some Imhoff tanks the slope of the bottom of the settling compartment has not been made steep enough so that settling solids will slide into the digestion compartment. Where this condition exists there is not much that the operator can do to change the tank design. To improve the situation, he must resort to measures that will help to prevent the sludge from building up on the slope, decomposing, and rising to the surface of the settling compartment as huge cakes of scum. Some operators have overcome this scum problem by providing lengths of log chain. In dragging the chain back and forth, they scrape the sloping sides of the settling compartment, tending to move the sludge through the slot. Other operators have made squeegees to use at least once each day for pushing the settled solids through the slot. It is more important to keep the slopes clean in summer than it is in winter because the gas formation takes place in the warmer weather at a more

rapid rate (bacteria digest solids at a more rapid rate when in a warm environment).

If the sludge does rise in the sedimentation compartment it usually can be broken up by a stream of water from a hose nozzle. Once the scum has been broken up and made to settle, steps must be taken to get the sludge through the slot into the digestion compartment. There have been cases where the sludge compartment became so filled with sludge that there was no place for the sludge to be deposited. In such cases the measures recommended will not be of any help. A good plant operator never will allow the sludge to accumulate to the point where it interferes with the functioning of the sedimentation process.

In some Imhoff tank installations there is no provision made to remove greases and oils; if not removed, these will rise and collect on the surface of the sedimentation compartment. They often look very much alike, but the plant operator must be able to distinguish the difference between floating sludge, and grease and oil. It would be a mistake to beat up the grease in an attempt to make it settle. The grease and oil type of scum must be skimmed off and hauled away for burial, incineration, or some other suitable method of disposal.

The proper period between reversal of flow in an Imhoff tank will depend to some extent on the difficulties encountered in making the change. There might be instances when it is necessary to change flow directions as often as once a week, but this would be unusual. A more reasonable period would be once each month.

About Sludge Digestion

In the sludge digestion compartment the anaerobic bacteria (the bacteria that do not require air) feed on settled sewage solids, and convert these solids into gas and water. The gases produced are carbon dioxide and methane. As these gases rise they stir up the sludge and carry some sludge particles to the surface in the gas vents. Solids exposed at the surface become dry and will not settle, unless the gas can be released from the solids before they have a chance to dry. In an Imhoff tank where there is biologic action, there will be an appreciable release of gas at the gas vents and rather violent agitation of the solids at the surface. Where the scum in the gas vents is thick and dry, it will not break up without agitation from an outside source such as that provided by using a fire hose with nozzle.

If was mentioned before that the activity of bacteria depends upon the temperature. This means that at summer temperatures the bacteria are more active than they are in the winter when the sewage is cooler. The temperature of the digestion compartment cannot be controlled; the large quantity of sewage flowing through the sedimentation tank maintains the temperature of the digestion tank at the temperature of the sewage. Thus, while the rate of *decomposition* of the sludge is slower in winter, the rate of solids *deposition* is about the same in winter and summer (if there are no unusual seasonal industrial loads).

In cooler climates there is practically no decomposition during the winter, and when spring and early summer arrive there is increased bacterial activity. With increased activity, there is a greater agitation and scum formation in the gas vents. This behavior, sometimes called *foaming*, causes a great deal of trouble. In severe cases the scum rises in the gas vents and runs over the sides of the tank into the upper flowing-through compartment. The odors that arise at such times are very objectionable, and frequently have caused complaints to be registered by nearby residents.

This same behavior may be a result of overloading the digestion compartment with sludge. There is apparently a relationship between the volume of a digestion compartment, average sewage temperature, amount of raw sludge deposited, and quantity of digested sludge in the digestion tank. Usually, when the foaming difficulty arises, the liquid in the digestion compartment becomes acid; to overcome the acid, lime has often been added. The addition of the lime may neutralize the acid condition but it does not correct the original cause of the foaming: the cause is the overloading of the digestion compartment.

The presence of well-digested sludge seems to be helpful in controlling "foaming." This may come about because of the buffering action of the digested sludge, or it may be because the digested sludge contains bacteria that serve as seed and multiply to decompose the raw sludge being added.

How to Handle Foaming

It is well to understand the cause of difficulties in operation but it is important to know what to do when the difficulties arise. In the case of Imhoff tank foaming, some operators just throw up their hands and give up, others pour lime into the tanks, and some may draw sludge onto the drying beds. There is nothing for the first type of operator to do but ask for more tanks, because he has said that he can do nothing with what he has. The second operator can add lime in a reasonable quantity sufficient to raise the pH to 7.0, the neutral point. The third operator can say that he intends to hold all the digested sludge possible in the digestion compartments during the colder months of the year. Following such a policy requires extremely good judgment regarding the accumulation of sludge over the winter months.

HAND skimming operation at an old Imhoff plant

ALLENTOWN, Pa., was one of few large cities to employ Imhoff tanks for sewage treatment
(Left to right) Sludge drying beds, Imhoff tanks, and trickling filters.
Circular final clarifiers are at center rear.

The most desirable situation would be to maintain the top of the sludge layer at about two feet below the slot on about June 1st, so that there will be the maximum amount of well-digested sludge present during the early spring when the digestion of the winter's accumulation takes place. These statements indicate that the fall drawing of sludge should not remove all of the digested sludge, as the well-digested sludge is helpful in maintaining good digestion conditions. Banta[1] has stated that sludge should be removed in small amounts at frequent intervals. It is apparent that the proper drawing of sludge from an Imhoff tank cannot be done without giving thought to the effect on the process. The operation of the Imhoff tank should be the first consideration in drawing sludge, not the condition of the drying beds or the wish of the operator.

It is quite necessary to determine the level of the top of the sludge in the digestion compartment at approximately two-week intervals. Various devices have been developed for locating the top of the sludge in relation to the slot. Some operators have been successful in using a log chain, lowering one end of it until it has surely reached below the level of the sludge; the sludge will cling to the links and thereby mark the location of the sludge. By marking the chain at the water level, then raising it and measuring the distance from the water level mark to the sludge one obtains the depth of sludge below the surface. Using the depth of the flowing-through compartment, it is possible to calculate the depth of sludge below the slot. Needless to say, handling the measuring chain is a messy job. A light portable reel can be used for handling the chain and make the job somewhat easier.

Van Kleeck[2] has described a commercial sludge sounder and sampler that he recommends.

Portable pitcher pumps with flexible suction lines have been used in locating the sludge blanket. This equipment is rather heavy to move about the tanks; every effort must be made to build it of light material so that it can be moved about as easily as possible. It is necessary to determine the depth of the sludge in several places in each tank, as the sludge is not laid down in equal depths in all tanks.

The information on sludge levels is important, since it is used as a guide in determining when to change direction of flow through the tanks and when to draw sludge to the drying beds.

Laboratory Tests

The Imhoff tank is a simple device that may operate with a minimum of attention. Like all processes and equipment, the *best* results with this unit can be obtained if knowledge on its effectiveness and efficiency is applied.

Many small sewage plants have been built without provision for a laboratory, but this need not stop an operator from making simple tests to determine how his plant is functioning. Dr. Imhoff appreciated this fact and developed the glass cone that bears his name, for determining the solids removed from sewage as it flows through the settling compartment. Samples of influent and effluent placed in Imhoff cones and allowed to settle, show the amount of settleable solids being removed. Two of these cones and a rack to hold them are all of the equipment required to make this useful test.

More detailed information on the efficiency of an Imhoff tank can be obtained by running tests to determine suspended solids, biochemical oxygen demand, oxygen consumed, and grease, as well as those for toxic materials that may be present in industrial sewages.

If suspended solids are determined in influent and effluent samples, the per cent removal may be calculated. Subtracting the effluent solids concentration from that of the influent, dividing the answer by the influent concentration, and multiplying by 100 will give the per cent removal. The removal will not likely be more than 60 per cent. If it is much less than this value, efforts should be made to increase the removal.

Drying Sludge Solids

It is desirable to have information on the concentration of the sludge solids drawn from the digestion compartment. For this purpose, it is more useful to determine the total solids content than the suspended solids content (the sludge usually is very difficult to filter). Knowing the volume of sludge drawn, by measuring the depth on the drying beds, it is possible to compute the pounds of solids removed. Perhaps more important than learning the quantity of solids removed is determing whether the sludge being drawn is thick or whether it is mostly water. This can be determined by watching the sludge being discharged. Thin sludge should not be drawn onto drying beds because it reduces the space available for digested sludge solids.

Difficulties may be experienced in drying sludge on beds. Sludge that

does not dry well usually is gray in color and lacks the tar-like smell characteristic of well-digested sludge. Also, poorly-digested sludge usually will not dewater well on the beds and should not be removed from the Imhoff tanks. A very rapid test known as the "Buttermilk Test," has been devised to indicate whether or not the sludge will dry when placed on drying beds. This test is made by filling a glass jug about one-quarter full with the sludge, shaking it to coat the inside of the jug and then observing what takes place. When the sludge drains down over the sides of the jug in little rivulets—like those that form when the same test is made with buttermilk—the sludge will dewater well on drying beds.

Conclusions

The Imhoff tank is a simple sewage treatment device used as a primary settling tank and a sludge digestion tank.

To get the best operating results with an Imhoff tank it is necessary to keep a close watch on the effectiveness of solids removal and on the accumulation of sludge.

Simple tests must be conducted to serve as guides in operation of Imhoff tanks, and more complete tests may be required under certain conditions.

References

1. Banta, A. P., "Sewage Treatment Plant Operation" *Water & Sewage Works*, Vol. 89, No. 6, pg. 200 (June 1942).
2. Van Kleeck, L. W., "Digestion of Sewage Solids." *Water & Sewage Works*, Vol. 95, No. 4, pg. 155 (April 1948).

Know Your Bearings*

Here is a chart that gives the answer promptly, and without any longhand figuring. Simply lay a straightedge across the chart three times, as indicated by the dotted lines, and you will find the horse power consumed by any bearing in column D.

For example, let us take "average practice" in column A, using a coefficient of friction of 0.02; a shaft diameter of 2 inches, column C; a speed of 2,000 r.p.m., column E; and a 400-pound load on the bearing, column G. Column D gives the friction horse power as a little over 0.25.

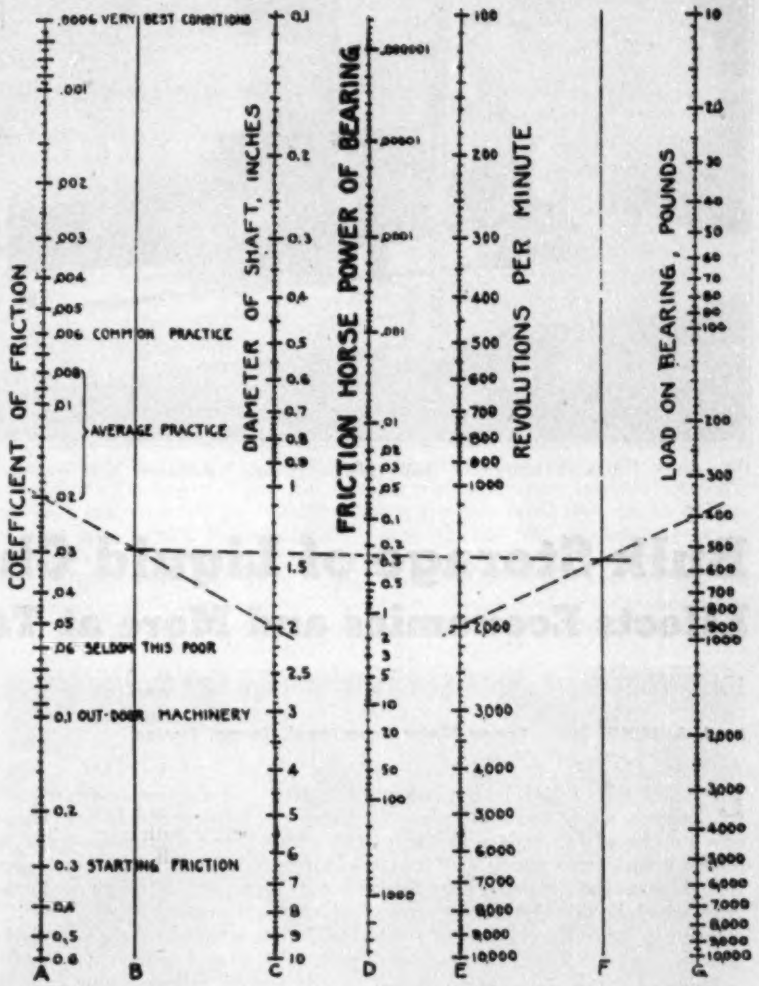
As shown by the dotted lines, connect the known value in column A with the known value in column C and locate the intersection with Column B. In the same way connect the known values in columns E and G and locate the intersection with column F. Lastly, connect the intersections—columns E and F—and the intersection with column D then gives the *friction horse power* of the bearing.

It will be observed that column A gives a good idea as to the coefficients encountered in everyday practice, beginning with the very best conditions and ending with starting friction.

The chart, of course, can be used backwards as well as forwards. Thus, knowing any four of the figures in the columns the fifth is readily found.

The chart explains many things; teaches many lessons. Thus, it tells us that low shaft speeds are preferable; that it is best to use small shafts; and keep bearings well oiled, with the proper oil, and in tip top condition.

* Contributed by W. F. Schaphorst, M.E., Newark, N.J.



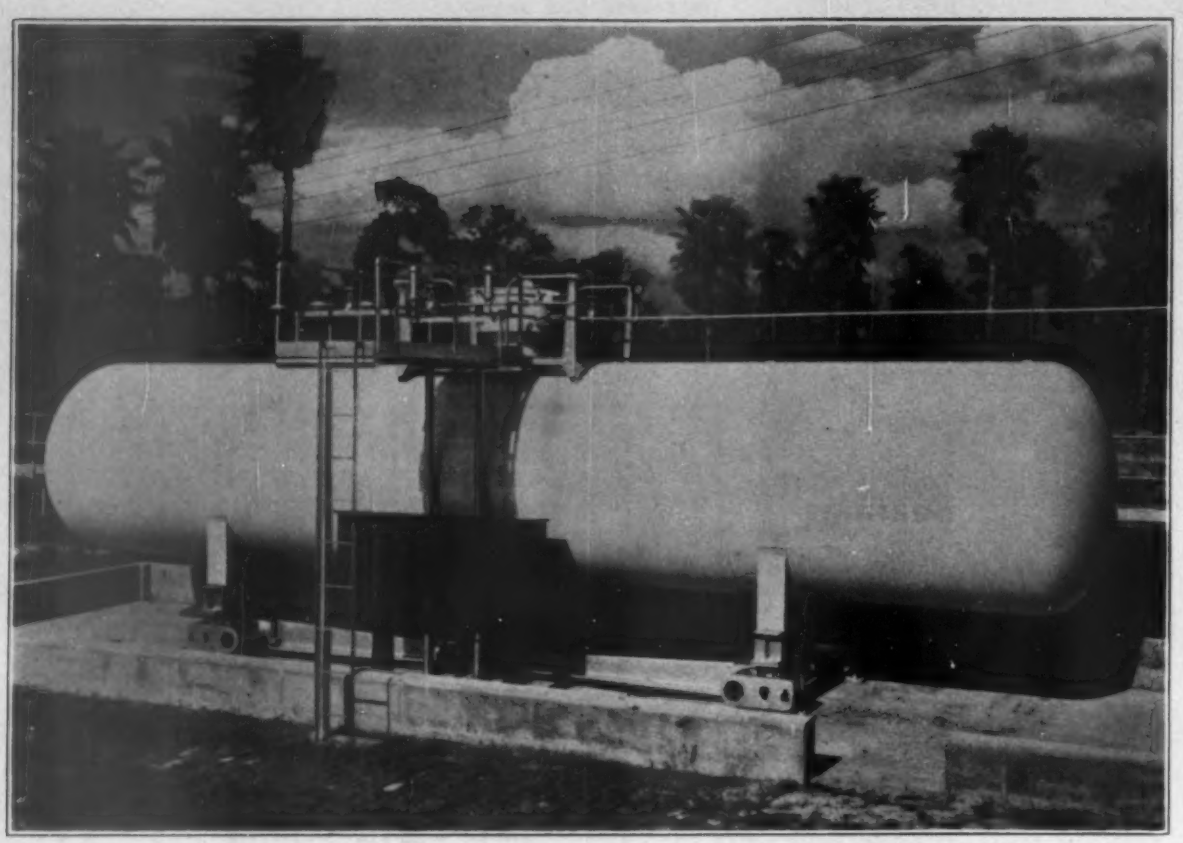
Water Rate Reduction Makes News These Days

A news item in the Cedarburg, Wis., News, telling of a decrease in water rates by the Cedarburg Water & Light Commission sounds, in these times of generally inadequate water rates, like a story of the "man bites dog" variety.

Aided by the Wisconsin Public Service Commission a re-alignment of charges for public fire protection service to the community and industry on a more realistic basis makes it permissible to reduce rates on water use to customers of the commission managed utility.

True the rate decrease amounts to only 6 to 8 per cent, depending on the volume used, but even this token reduction reveals the financial health of the Cedarburg Water System, the soundness of local Commission Utility Management and the value of State Public Service Commission guidance in municipal water utility financing and operation.

Supt. Palmer Schneider is happy about the whole thing, as are the people of Cedarburg. Judging from the published comparison of old and new rates, which reveal no flat rates, Cedarburg is essentially 100% metered.



FIRST waterworks bulk chlorine storage installation. Note scale mounting of 45-ton capacity tank.

Bulk Storage of Liquid Chlorine
Effects Economies and More at Tampa

First Waterworks to Adopt Bulk Storage of Chlorine

by **J. S. LONG, *Supt., Tampa Water Department, Tampa, Florida***

LIQUID CHLORINE for use at Tampa's water treatment plant is now purchased in single unit thirty-ton tank cars from which it is transferred to a stationary storage tank from which liquid chlorine or gaseous chlorine is fed to the chlorinator room at will.

Primarily, the decision to install stationary storage for chlorine was motivated by the two universal goals of water works management—uninterrupted service and economical operation. The previous system of purchasing chlorine in ton containers in multiple unit tank car lots caused many anxious moments when receipt of scheduled shipments was extremely doubtful. Economy of operation is of paramount importance because Tampa's water is inherently very difficult and expensive to treat. Preliminary investigation indicated stationary storage would help to insure an adequate and continuous supply of chlorine and would also effect operational economies through reduction of chemical costs.

The site selected for the installation is parallel to and at the closed end of a city-owned railroad spur into the water treatment plant. This area is adjacent to the sedimentation basins, the bulk line storage building and the chemical storage portion of the main filter building. It is approximately 190 feet from the chlorinators.

The Installation

Broadly speaking, the installation consists simply of a storage pressure tank mounted on a scale, equipment for cleaning, drying and compressing air, and interconnecting piping. The scale mounting was selected as the *surest and simplest method* of accurately determining both the tank contents at any time and the amount of chlorine used each day.

The Scale

The scale is a pipe lever type tank scale, 20′-0″ x 6′-0″ centerline to centerline of bearings. It has a net capacity of 90,000 lbs. and gross capacity of 125,000 lbs. It is installed in a concrete pit so designed as to be capable of supporting a building to house the tank if that ever becomes desirable. The pit is so oriented as to provide the minimum required clearance for the railroad spur and to make the top of the storage tank approximately level with the top of the spotted tank car. Inquiries revealed that the most readily available con-

tainer for shipping liquid chlorine is the single unit tank car of thirty tons capacity, so it was decided to size the storage tank to hold 45 tons, thus leaving a margin of 15 tons for ordering and receiving cars.

The Storage Vessel

The actual size of the tank was determined for the volume of 45 tons of liquid chlorine at 155°F. plus 20 per cent of this volume for gas space. The tank itself is built in accordance with A.S.M.E. code for Unfired Pressure Vessels, paragraph U-68 from plates in accordance with A.S.M.E. specifications S.A.-212, grade B firebox quality steel. All longitudinal and circumferential tank seams are welded by the "Unionmelt" process and all other seams are electric arc welded. Seams have 95% efficiency and all welds were radiographed and stress relieved. The tank is 7'-1" inside diameter by 38'-0" overall length with shell thickness of 47/64" and semi-ellipsoidal head thickness of ¾". The tank is designed for 225 psi. working pressure and was subjected to hydrostatic test pressure of 400 psi. The tank is equipped with a standard 18" manhole, dome and platform arrangement, except that subway grating was substituted for the standard wood platform flooring.

The valve arrangement in the dome and the eduction pipes in the tank are identical with standard equipment on a 30-ton liquid chlorine tank car. There is no other opening into the tank. Two steel cradle supports are attached to the tank in such position as to match the scale girders (see photograph).

The tank is not insulated nor is it provided with a sunshade for the reason that it is desired to feed only gaseous chlorine from the tank, but as a precaution against unduly high pressures in Tampa's warm climate the tank is finished in heat reflective white enamel. A steel catwalk is provided to extend from the tank platform to the clearance line for the railroad spur. To the catwalk a ladder is attached for access to the storage tank dome. When the tank car is spotted, a temporary bridge is used.

Dry Air Compressor

The air cleaning, drying and compressing equipment is installed in the nearby bulk-like storage house and consists of an air compressor equipped with aftercooler, an oil filter and an air dryer. The compressor is a conventional 2 stage type 36 cfm. piston displacement unit mounted on an air receiver. The aftercooler is designed to cool the compressed air to a maximum temperature of 100°F., when the maximum temperature of the cooling water is 86°F. The oil filter, placed between the air compressor and the air dryer, is designed to trap out any entrained vapor stage oil coming from the air compressor, which might well prove dangerous if allowed to mix with the chlorine; and also, to remove impurities which would unnecessarily clog the dessicant in the air dryer.

The air dryer is a one-compartment regenerative type, using activated alumina as the dessicating agent. It is capable of drying the output of the compressor to a dewpoint of minus 20°F. when run continuously for not more than eight hours. Since this installation is used solely for "padding" chlorine cars, which is an intermittent operation allowing regenerating time between cars, the single compartment dryer is satisfactory. The term "padding", as employed by the industry, means the introduction of compressed air above the liquid chlorine to cause the car to empty at a more rapid rate than can be effected by the natural chlorine gas pressure.

Mr. Long's article, scheduled for our January issue, unfortunately had to be held for this issue.

Although this same article has in the meantime appeared elsewhere, the importance of the development warrants its publication a month late in *Water & Sewage Works*.

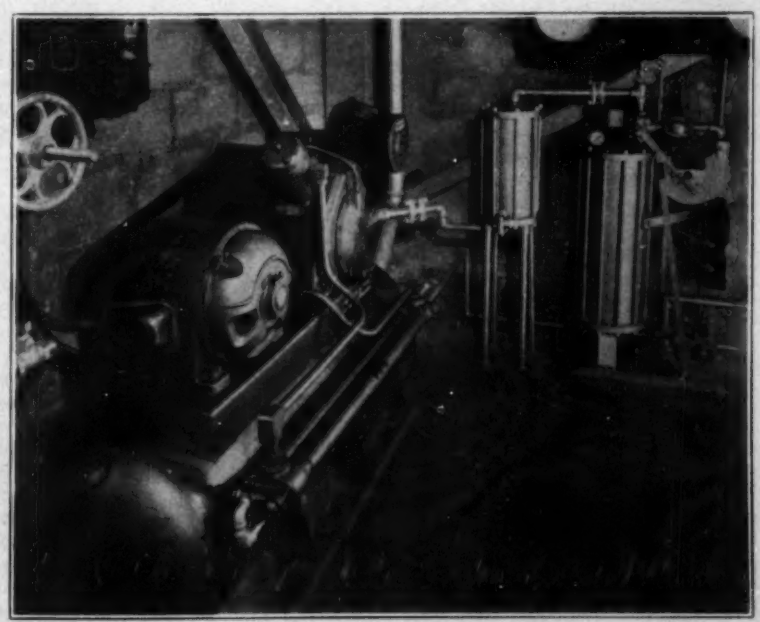
In our October 1953 issue we featured an article describing the pioneering installation of bulk-storage of liquid chlorine in the water and sewage field—the installations at San Francisco's two major sewage treatment plants.

Tampa's installation, being the first in the water works field, to our thinking represents another milestone in chlorination practice.—Ed.

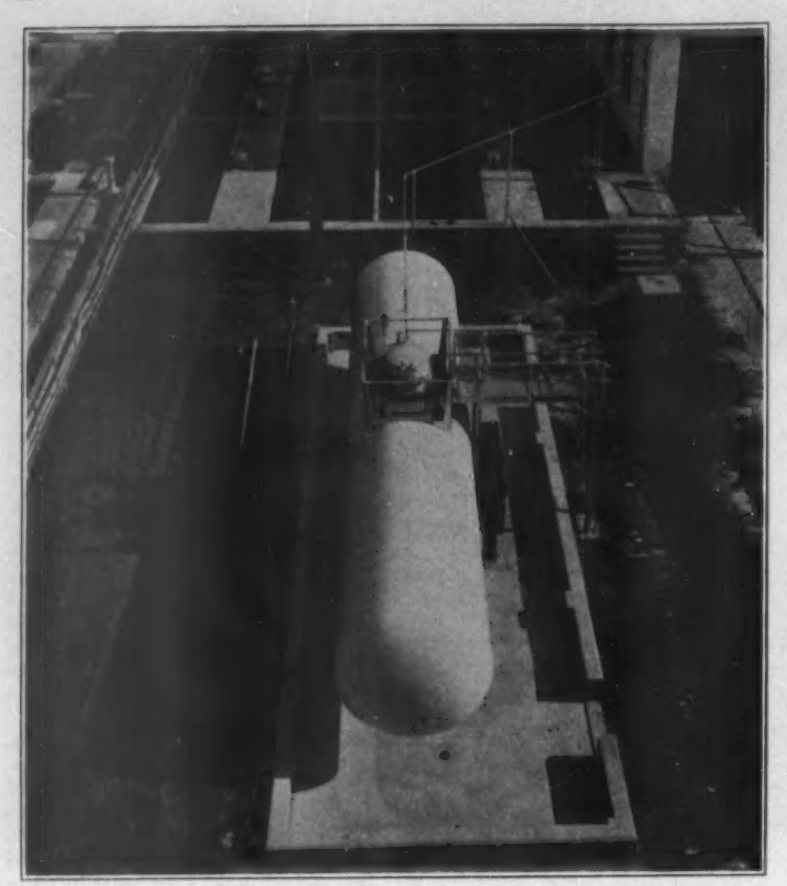
The Pipe System and Safety Precautions

Pipe used throughout the system is schedule 80 black genuine wrought iron of 1" nominal diameter with screw ends made up with white lead paste joints. Fittings are 2000 lb. W.O.G. forged steel. Flanged unions are standard ammonia type. Valves are forged steel globe valves especially made for chlorine service. The discharge end of the air dryer is permanently piped to the tank car end of the catwalk from which point it can easily be connected to either the storage tank or the tank car. Permanent piping is installed from each of the two liquid valves in the storage tank dome to the tank car end of the catwalk and are temporarily connected to the two liquid valves in the tank car dome for "padding" when transferring liquid chlorine from tank car to storage tank.

In each of these lines is an expansion chamber and a shut-off valve. The expansion chambers guard against rupture of the connecting piping in case liquid chlorine is inadvertently trapped in the lines, and the shut-off valves are used to regulate the flow from tank car to storage tank during the unloading process. These two lines are interconnected with each other and with the gas line from storage tank to the chlorinators, properly valved, so that when unload-



PRESSURE booster installation—air drier, compressor and oil removal filter.



SOMETHING new in waterworks equipment in this 45-ton chlorine storage tank in the side yard of Tampa's water treatment plant.

ing is completed any chlorine remaining in the tank car and in the lines may be drawn off to the chlorinators. One gas valve in the storage tank dome is piped directly to the chlorinators. This line, besides being interconnected with the two liquid unloading lines, is also interconnected to one liquid valve in the storage tank dome, properly valved, in case it ever becomes desirable to draw liquid from the storage tank to evaporators ahead of the chlorinators. This gas feed line is piped overhead on pipe supports across a corner of the mixing basins, then strapped to the outside of the main building to a point outside the chlorinator room from whence it goes through the wall and is connected to a pressure reducing valve just inside the chlorinator room.

At the point where the line passes over the mixing basins, a valved connection equipped with a vacuum breaker is connected to a perforated grid placed on the floor of the mixing basin for the purpose of diffusing chlorine when it is found desirable to sniff off any quantity in excess of what the chlorinator will take. Also, in this line, an expansion chamber is provided to avoid rupture from any increase in pressure. A pressure gauge especially designed for chlorine service is permanently installed in the piping adjacent to the storage tank dome in such position as to always show tank pressure, regardless of valve settings. Flexibility between storage tank, tank car and permanent piping is provided by ball and socket type flexible joints having "Teflon" gaskets.

Placing the Installation in Operation

After installation was complete, all interconnecting piping was cleaned by flushing with carbon tetrachloride. The storage tank dome cover was removed and the inside of the tank was thoroughly inspected, cleaned and dried. After the dome was reassembled, dry air was passed through the entire system and then pressure to 150 psi was built up on the system with dry air, during which time possible joint leaks were sought by using soapy water. The tank was then valved off and a ton container of chlorine was connected to the pipe system, which was tested for leaks with ammonia. The tank was allowed to remain under 150 lbs. air pressure until the chlorine car arrived. It was then exhausted.

When everything appeared in order, a tank car of chlorine was ordered. When it arrived and was placed adjacent to the storage tank by the railroad, the derail was set on the open end of the spur track, and the conventional sign to advise railroad personnel of a connected tank car was placed. The tank car was then accurately spotted by means of a hand car pincher, the brakes set and wheels chocked. The valves in the tank car dome were connected as follows: The two liquid valves to the two liquid unloading lines, one gas valve to the dry air supply and the remaining gas valve to a pressure gauge to show tank car pressure. All valve settings were checked and the two shut-off valves in the unloading lines were closed. Extreme precaution was taken in admitting only a small amount of chlorine into one unloading line at a time until it was again certain that there were no leaks. Some leaks were detected in the flexible joints, but were easily stopped by tightening the packing glands. When all leaks were stopped, the two liquid valves in the tank car dome were opened wide with the two control valves in the unloading lines closed and then the control valves were operated to allow the maximum flow by the ball check valve. Padding was not immediately required since there was no pressure in the storage tank, but as the pressures in the two tanks became equalized, dry air was introduced into the tank car and unloading was accomplished without difficulty in about six hours. Residual chlorine in the piping system was drawn off by the chlorinators and air pressure in the tank car was exhausted through the grid system in the mixing basin before the tank car was disconnected.

Only One Difficulty Experienced

The system was placed in operation on May 17, 1953 and since then only one difficulty has been experienced. As has been noted previously, the chlorine feed line is attached to the outside of the building for a distance of approximately 100 feet. This line, naturally, becomes quite warm on a hot summer day and on several occasions, after a cooling late afternoon thunder shower, the gas in the line reliquefied. Some liquid got by the pressure reducing valve with the result that the orifices in the chlorinators became clogged. This difficulty was solved by connecting the feed line into a 150 lb. chlorine cylinder

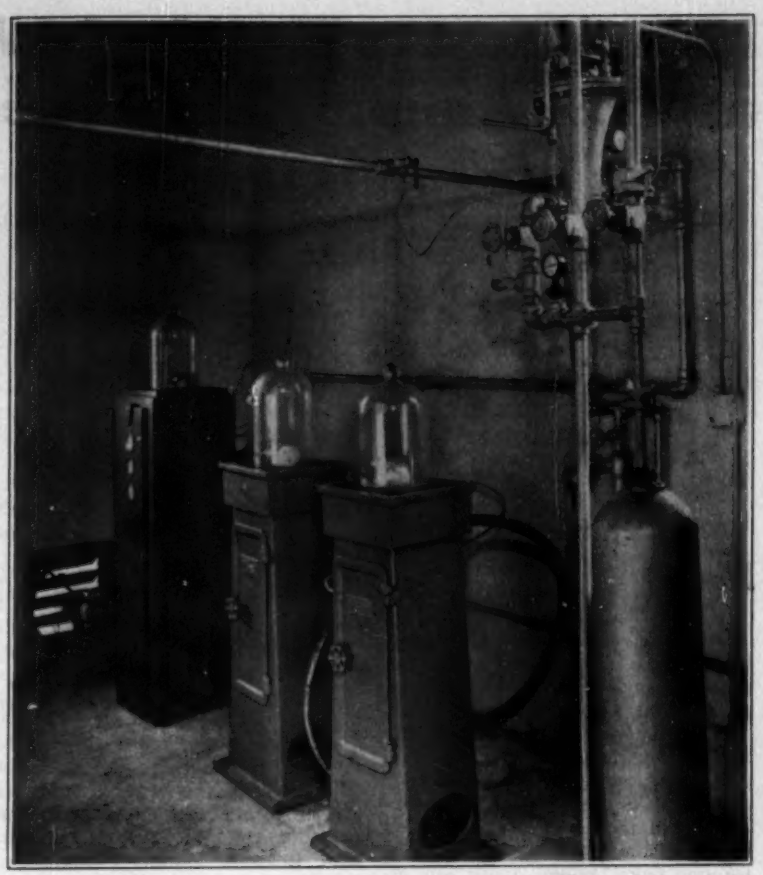
set upright on the floor of the chlorinator room—see photographs. The connection to the pressure reducing valve was teed off of the feed line above the cylinder with the result that any liquid in the line now goes into the cylinder and by virtue of the warmer atmosphere in the chlorinator room is soon re-evaporated.

Safety Precautions

Standard safety precautions are observed in handling chlorine. Approved gas masks are kept conveniently located in strategic places and all work in connection with the system is done by *especially trained personnel*. In case of serious difficulty, it is intended to exhaust the chlorine through the grid system in the mixing basin while feeding hydrated lime as a neutralizing agent. The water so treated can be isolated and wasted.

Overall cost of the installation is estimated at $16,000.00 of which $12,000.00 is for materials and equipment and $4,000.00 is construction cost. This cost does not include any engineering fees or superintendent's wages.

It is thought that stationary storage presents no particular hazards when properly handled. In fact, exposure of personnel to hazards of handling and connecting chlorine containers has been reduced from once every few weeks to once every three or four months. It is further thought that the goals sought have been achieved in more dependable supply and lower operating cost. Finally, the idea of the uninsulated, unshaded tank is justified by the fact that at no time during a hot summer with a relatively full tank did the tank pressure exceed 128 psi gauge.



CHLORINATOR room, Tampa, Fla. Note the liquid chlorine trap in right foreground.

The system was designed by Robert and Company Associates of Atlanta, Georgia, and was constructed by city forces under the supervision of J. A. Link, Resident Engineer.

The water treatment plant is under the direction of J. L. Burnett, Supervisor of Filtration. Acknowledgment is made of the cooperation and many valuable suggestions of Columbia-Southern Chemical Corporation.

Latest Fluoridation Results Released by Sheboygan

One of the earliest cities to adopt water fluoridation for the protection of children's teeth against decay.

Although the water treatment did not come up to expectation of many in regards the extent of reduction of tooth decay amongst the children, nevertheless the treatment has proved worthy of adoption and the costs justified as the following excerpt from the official report attests.

Sheboygan, Wis.—For the 8th successive year since the beginning of water fluoridation here, there has been a substantial reduction in the incidence of tooth decay.

This was announced over the week end by Dr. G. J. Hildebrand, commissioner of public health, in releasing results of the city's annual dental survey.

Fluorides in municipal drinking water have brought about a 63% reduction in the amount of tooth decay among senior kindergarten children, according to the report.

Sheboygan was one of the first of three cities in the U.S. to adopt water fluoridation. Wisconsin leads among the states in fluoridation, with more than 70% of the population now being served fluoride enriched water. The largest city, Milwaukee, started fluoridation in July of last year.

Increasing Water Yield by Thinning Trees

Findings of twelve years of research by the U. S. Forest Service indicate that the periodic thinning of young trees can produce a permanent increase of 25 per cent in water yield from a watershed.

The experiment carried on at Fort Collins, Colo., revealed that as much as 30 per cent more water could be produced from an area where the mature trees were cut in dense virgin stands of lodgepole and Engelmann spruce. These thinnings open up spaces into which winter snows can pack in greater depth, and hence increase the useful summer runoff of water.

Miami Host to Florida A.W.W.A. Section at 27th Annual Conference

Chairmen

Retiring
Charles H. Helwick
Superintendent
Water Dept.
Jacksonville

Incoming
Marvin R. Boyce
President
Boyce Co., Inc.
Clearwater

NEW OFFICERS

Chairman
Marvin R. Boyce, Jr.
Vice-Pres., Boyce Co., Inc.
Clearwater

Vice-Chairman
D. W. Jones
Supt., Water Dept.
North Miami

Secretary-Treasurer
Harvey T. Skaggs
Gen. Mgr., Amica-Burnett Chem. Co.
Jacksonville

National Director
Wylie W. Gillespie
Partner, Smith & Gillespie
Jacksonville

New Trustees
A. O. Patterson, U.S.G.S., Ocala
Ellis K. Phelps, W. & T. Co., Orlando
Clarence R. Henry, W. & S. Dept., Miami

AWWA Directors

C. F. Wertz
Resid. Engr.
Water & Sewer Dept.
Miami

W. W. Gillespie
Partner
Smith & Gillespie
Jacksonville

MIAMI proved an ideal location for the twenty-seventh conference of the Florida Section of the American Water Works Assn. on October 11-13, 1953. The meeting got under way on Sunday evening with registration and a get-acquainted party, held its busy technical sessions on Monday and Tuesday, and ended with a plant inspection trip on Wednesday morning. As the F.S. & I.W.A. conference in the same city started on Tuesday, the programs did overlap for one day; but apparently the attendance at both associations was increased by the proximity of the two meetings.

CHARLES H. HELWICK, Supt., Water Dept., Jacksonville, was chairman of the Florida section, and HAROLD D. BRILEY, of Briley, Wild & Assocs., Daytona Beach, was chairman of the program committee. In the business meeting it was announced that the section now has a membership of 325. New officers were elected for the coming year.

There was an inspection trip to visit the new 40 mgd Miami Southwest Water Treatment Plant. This plant is not yet in full operation, but is nearing completion.

Social Events

In addition to the get-acquainted party which opened the meeting, the manufacturer's club room proved to be a well-patronized meeting place. Clubroom entertainment was sponsored by the W. & S.W. Mfrs. Assn. and other manufacturers' representatives attending the conference. The banquet, followed by entertainment and dancing, was the high point of the meeting.

For the ladies, there was a special program which included a luncheon and fashion show at a Miami Beach hotel.

Awards Presented

The *George W. Fuller Award,* for service to the Florida Section, was presented to R. HOSEY WICK, Chairman, Board of County Commissioners, Pinellas County, Fla.

The *Dr. A. P. Black Cup,* awarded for securing the highest number of new members for the Florida Section, was won by D. W. JONES, Supt. Water Dept., North Miami, Fla.

Technical Program

Mayor CHELSIE J. SENERCHIA, of the City of Miami, opened the technical sessions with an address of welcome to the conference. He demonstrated considerable knowledge of, and interest in, the Water and Sewer Dept. of his city. The organization of the department, which now provides water for a population of over 500,000, was described.

Water Industry Problems

"SOME GENERAL PROBLEMS OF THE WATER WORKS INDUSTRY" were described by Harry E. Jordan, Secretary, A.W.W.A., New York, N.Y.

The primary consideration reviewed by Mr. Jordan was that of expanding needs for water. Early in 1953, a Public Works survey reported increasing water consumption ranging from 15 to 20 per cent—and the need for system expansion to be 35 per cent.

The A.W.W.A. reported in July the results of a study made of cities over 25,000 population which revealed a 20 per cent increase in water use. Most strikingly, replies made evident cities (almost 52 per cent) needed greater distribution system facilities to meet demands for water. In many instances, management has failed to predict these expanding needs.

In the period 1950 to 1975, total U.S. population is expected to increase 33 per cent—but water use increases (at a conservative estimate) one and one-half times as rapidly as the population increase. Predictions are for a 50 per cent increase in municipal water requirement, a 170 per cent industrial increase, and a 25 per cent increase in irrigation. Our water

Association Banquet

Left to right: Ralph W. Baker, State Bd. of Health; Harvey Skaggs, master of ceremonies; Mrs. Marvin Boyce; Fuller Award presentation, to R. H. Wick by Harry Jordan; A. P. Black Cup presented to D. W. Jones.

works industry must be in a position to meet these demands—and will need proper rate structures to do so. Mr. Jordan considered the Board or Authority (largely free from political control) to be a means for managing public water utilities which generally can be praised.

New Trustees

Clarence R. Henry, Chief Chemist, Water & Sewer Dept., Miami

Ellis K. Phelps, Sales Engr., W & T Co., Orlando

The water works industry is, unfortunately, considered only a part of local government (of 914,000 municipal employees, 81,000 are in publicly owned water plants—according to a 1952 census). Here's the rub: the monthly average salary for water works employees at that time was only $294 per month; average compensation for water works employees is less than for other public jobs. Meanwhile the public has accepted the need for greater salaries for school teachers (average $366 per month) and for fire department employees (average $326 per month). There are hopeful signs in examples of better salaries, especially where an Authority manages the water supply.

Mr. Jordan said, "You get what you pay for in service." In a survey of water systems in a midwestern state, it was found that 1 of 5 water superintendents had no previous experience leading to the job—and 1 of 4 lacked even a high school education. There must be developed a long-range approach: water works management will more and more compete with industry. There is a crusade ahead: large scale building and financing are needed to meet coming requirements— to do so, the public must be informed and made to understand.

Invisible Reservoirs

"AN ISLAND WATER SUPPLY" was the title of a paper prepared by Geoffrey C. Stubbs, Director of Public Works, and A. C. Langlois, Deputy Director of Public Works, Nassau, Bahamas, and presented by Mr. Langlois.

Nassau was described as the only place in the world where the collection of a large supply of fresh water *below saline water* is attempted. The pumping rate is of prime importance in making this possible. The subterranean reservoirs drawn upon are 30 feet or more below mean sea level. Replenishment of the reservoirs is only through rainfall.

An area 100 yards square has been shown to supply 2,900 gal. per day; but, to be conservative, the maximum withdrawal (in order to insure replenishment) is restricted to 960 gal. per day. Practice shows the operation of a large number of small wells is better than one large well. The present average demand is 600,000 gpd, and the maximum is 750,000. This volume is supplied by three areas, each about 200 acres in size.

There are now 285 pumping units to operate 700 to 800 wells.

The variety of pumps employed is certainly unusual: deep and shallow well pumps; windmill operated pumps (most reliable but subject to hurricane damage; 140 in use); hydraulic jet pumps; air lift pumps; ejector type pumps; and electric piston pumps. Water charges begin at $.82 per thousand gal. and are fixed on a sliding scale *upward* as the use increases.

Planning More Water for the City of Havana

"PROJECTED EXPANSION TO THE WATER SUPPLY OF HAVANA" was described in a paper prepared by Manuel J. Puente and Garcia Montes, Consulting Engrs., Havana, Cuba, and presented by Mr. Puente.

Mr. Puente reported on progress made in correcting the sad (or what he termed the "calamitous") situation which followed the almost complete abandonment of Havana's water works for a period of almost 30 years and, particularly, the financial and technical "dark page" in the history of the utility following the 1944 change in government. The latter will cost Havana more than $14 million—because material and labor costs have more than doubled from 1943 price levels.

Fuller Award

Comm. Chmn. Fred A. Eidsness, Cons. Engr., Black and Assocs., Gainesville

Recipient R. Hosey Wick, Chairman, Board of Commrs., Pinellas County

In 1948 the municipality started construction of a 66-in. trunk line, using funds from surplus revenues. In the last four years, work costing more than $4 million has been completed, including new wells, a 6 mg storage tank, pumping equipment, and branch pipe lines. While at present there is more need of expenditures for water mains than for water —but more water will soon be needed than wells can supply.

Three drainage areas are being extensively studied, and it appears that the cities of Havana and Marianao can together reach a practical solution of future water supply. On the basis of utilizing a Southern water supply at an estimated cost of $14 to $15 million, no cheaper 25-year solution can be suggested. The Southern drainage area has a potentiality of more than 600 mgd (total additional requirement of the two cities by 1977 is estimated to be 100 mgd).

Facts of Life in Florida

"GROWTH OF WATER SYSTEMS DUE TO POPULATION INCREASES" is a problem characteristic of Florida, according to Charles E. Richheimer, Partner, Reynolds, Smith, and Hills, Jacksonville, Fla. He used two water systems to illustrate a situation typical of that along Florida's fabulous "Gold Coast"—between Homestead on the south and Palm Beach on the north.

Entertainment and Dancing

Left to right: The spotlight on professional dancers and singers; like old times—Bill Orchard at the piano leading a song; members dancing in the McAllister Hotel Bayview Room.

Program Comm. Members

Harold D. Briley
Vice-Pres.
Briley, Wild & Assocs.
Daytona Beach

John B. Miller
San. Engr.
State Bd. of Health
Jacksonville

Short School Chmn.

Thomas Paul
Chem. & Chief Oper.
Water Dept.
Bradenton

Club Room Chmn.

John E. Baber
Salesman
T. C. Heywold Co.
Jacksonville

In the town of Hollywood, a water softening plant of 1.5 mgd capacity was ample to meet water needs in 1937. An increase in capacity to 2.0 mgd was required by 1941, and a further increase to 4.3 mgd in 1947. At that time it was considered that further additions would not be required until 1957. But, by 1951 the demand on the plant exceeded 5 mgd. By the end of 1953 the plant capacity was to be increased to 8.6 mgd, with provision to further increase the capacity by 2.7 mgd within a 60-day period when further increase became necessary. The well water softening plant of this city is a sea water-regenerated zeolite plant, set up on a unit basis.

The story of growing water consumption in North Miami Beach was cited as another example. In 1948 there were 700 residences; by Feb. 1, 1951, a consolidated water system served 1,013 accounts; six months later there were 1,611 accounts; and by Feb. 1, 1952, the system served 2,289 (thus, more than doubling in one year). But the community *really* grew in 1952—since, as of July 1, 1953, there were 6,100 consumer services.

Engineers must base their judgment on past knowledge and experience in a particular area: this is particularly important in communities whose growth is so phenomenal. Financing the required expansion programs is a problem in itself.

Another Expanding Supply

"A County Commissioner Looks at His Water Problem and Its Solution" was the title of a paper presented by R. Hosey Wick, Chmn., Board of County Commrs., Pinellas County, Fla.

Mr. Wick described his as the only Board of County Commissioners in Florida that operates a water system. Pinellas County, a narrow peninsula south of Tampa, borders on the Gulf of Mexico. It contains about 187,500 acres, with 30% included in cities and towns—St. Petersburg, Clearwater, Gulfport, etc. The Board recognized a need for an overall water system in 1933; construction began in 1935. An impounded surface supply, with storage tanks and distribution lines started operation in 1937.

By the end of the first fiscal year the system had 200 customers, and it was predicted that it would be a financial failure. Revenue for the first month was $121, while monthly revenue in 1953 was $30,500. The story of the rapid expansion (particularly post-war), which led to this development—and how it is continuing—was reported by Mr. Wick. New wells, new storage, new lines, and new services have been included in the constant expansion required.

Successful Removal of Sulfides

"Hydrogen Sulfide Problems of Small Water Supplies" were the subject of an investigation reported by Sidney W. Wells, Chemist, Div. of Water Supply and Treatment, State Board of Health, Jacksonville, Fla.

Mr. Wells made this study to determine the efficiency of various methods actually used in water systems near Jacksonville for hydrogen sulfide removal. The treatment processes used (principally on small subdivision water supplies) are: aerators in elevated tanks, atmospheric aerators, aeration with compressed air in hydropneumatic tanks, or chlorination for oxidation. The data presented will constitute a valuable literature reference.

A brief summary of Mr. Wells' findings: In elevated storage tanks, the reduction of dissolved sulfides through aeration and oxidation is effective if the detention period is about 2.5 to 3.0 hours. Atmospheric aerators of the design described can reduce dissolved sufides by 35 to 45 per cent (see illustration of this type).

Complete removal of dissolved sulfides, using slat tray aerators and ground storage reservoirs, requires a detention period of one to two hours. In hydropneumatic tanks, aeration and oxidation accomplishes removal in 20 min. or less under ideal conditions; porous media diffusers are desirable for mixing air and water.

Aeration, followed by natural oxidation in reservoirs should not be relied upon for complete removal of sulfides; secondary chlorination is recommended for the purpose.

Fluoridation Panel

A panel "Review of Fluoridation Progress" was presided over by Dr. A. P. Black of the University of Florida, as moderator.

Dr. J. E. Edwards, of Coral Gables, Fla., presented a thumb-nail sketch of fluoridation history in water supply and said that it was regrettable that there had been objectors to this progressive movement as had been true in the case of other such movements.

Dr. Floyd DeCamp, Director of Dental Health, Florida Dept. of Health, recounted the results from 8 years of controlled fluoridation at various points which assure better than 60% reduction in caries amongst the children under 12 years of age. He told of the 5-year study planned for Gainesville, Fla., covering 4,000 children.

John V. Miner, Jr., San. Engr., USPHS, Atlanta, Ga., reported that in the U.S. as of Oct. 1, 1953 there were 817 communities receiving flu-

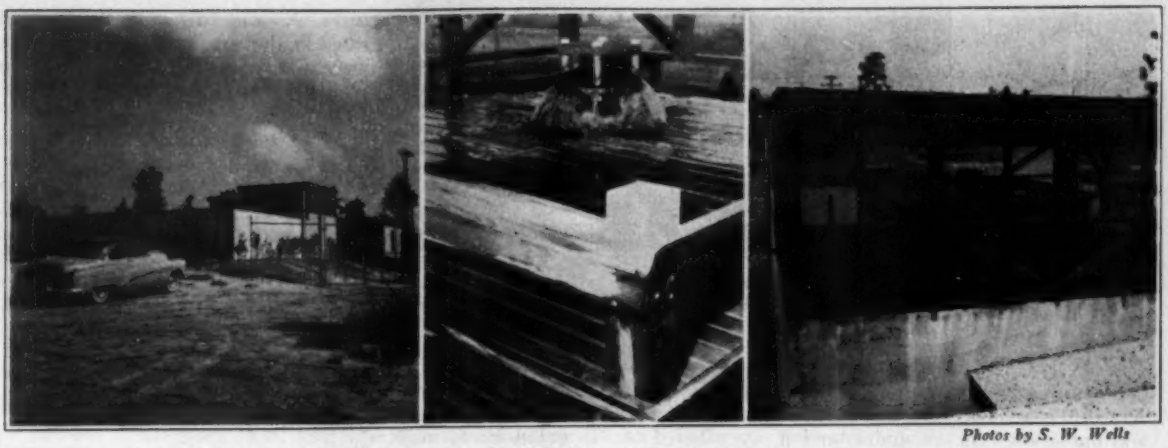
Programmers

Harry E. Jordan
Natl. Secy.
Am. Water Works Assn.
New York, N.Y.

Manuel J. Puente
Cons. Engr.
Puente & Montes
Havana, Cuba

C. E. Richheimer
Cons. Engr.
Reynolds, Smith & Hills
Jacksonville

S. W. Wells
San. Engr.
Bd. of Health
Jacksonville



Photos by S. W. Wells

Hydrogen Sulfide Removal by Aeration

Left—Arlington Manor subdivision water plant near Jacksonville, the 108,000 gal. ground water storage tank and plastic screened aerator. Center—Slat tray aerator with artesian well discharging at 105 gpm. Right—Plastic screening to protect the aerator.

oridated water from 433 water systems supplying 15,681,000 persons. He discussed the sources of fluorides for water treatment, cost of each in Florida (18.5 cts./lb. for colored sodium fluoride vs 13.5 cts./lb. for colored sodium silico fluoride), and chemical feeders appropriate for fluoride feeding under various conditions.

DR. BLACK closed the discussion by reminding his listeners that the AWWA policy was one of approving properly applied fluoridation without promoting the procedure. It might be said that AWWA supports fluoridation whenever the authorities and the people of a community wish to adopt water fluoridation. That is quite different from advocating or promoting fluoridation.

Miami, the largest city in Florida, is providing 0.8 ppm. fluoride in summer and 1.1 parts in winter. The raw water naturally contains 0.6 parts of which one-half is removed in the softening and filtration process. At Sarasota where the water naturally contains 2 ppm. fluoride, a study of 200 children indicate that 64% are without caries and there had been no tooth staining or chalking of any consequence, according to Dr. DeCamp, even with this naturally high fluoride content.

Programmers

Lois Jordan Schulze
Membership Secy.
Am. Water Works Assn.
New York, N.Y.

Thos. Charbonneau
Sales Engr.
Permutit Co.
Jacksonville

Safety Programs Weak

"HOW 'WET' IS YOUR SAFETY PROGRAM?" was the question raised by an interesting and forceful speaker, A. P. MCINTOSH, Director of Industrial Safety, Florida Industrial Comm., Tallahassee, Fla.

Mr. McIntosh stated that contrary to general belief the records do not show that water works operations have a low accident frequency record. What the record for Florida does show is the following:

Years	Water Works Accidents Reported	Total Cost
1950	3470	$173,000
1952	4460	$330,000

which indicates only a 21% increase in number of accidents reported but the cost of these accidents increased 91% in the two years. And this does not include the cost to the water works of time lost from the job. Such a record indicates an expected increase in compensation insurance rates in 1954 on water works employees.

In an attempt to procure an explanation for the lowering of safety records in water works operation, field reports would indicate that long term tenure of supervisory personnel may well be the explanation. These men have probably not kept up with modern safety procedures although they are working with speedier modern equipment.

Mr. McIntosh advocated that the responsibility for safety be placed in the hands of just one man charged with decreasing hazards and advancing the safety record. It would be surprising to see what can be accomplished.

Fresh Water from Sea Water

"SEA WATER DE-SALTING" by Dr. C. E. REID, Dept. of Chemistry, Univ. of Florida, and Fred A. Eidsness, Black & Associates, Engrs., Gainesville, Fla.

Mr. Eidsness introduced the subject by telling of the Univ. of Florida project studying the possibility of a practical method of de-salting sea water or other saline waters. An $18,000 grant had been made for the first year's study from the Federal Government. The Florida study is devoted to high pressure osmosis. The principle of pressure osmosis offers the best chances of developing a practical method at lowest cost. The present problem is the development of a membrane to stand the required pressures. Polymeric plastics hold the greatest promise.

Dr. Reid presented the physical-chemistry involved in osmosis and the relationship of hydrostatic pressures to efficiency in separation of salt from water to various degrees of completeness.

Main Extension Policies

A panel dealing with "WATER MAIN EXTENSION POLICIES" was moderated by DAVE LEE, Chief Sanitary Engr., Fla. State Dept. of Health, Jacksonville.

Mr. Lee said that with Florida's growth at the rate of 250,000 population influx per year the problem of financing water main extension was a real one and state-wide.

FRANK SHOCKTER, Asst. Supt. at Jacksonville, reporting for Supt. Chas. Helwick, stated that Jacksonville's policy was that of requiring the real estate developer to pay all costs of extension put in under water department supervision and thereafter

David B. Lee
Chief San. Engr.
State Bd. of Health
Jacksonville

Stanley Sweeny
Superintendent
Water & Sew. Dept.
Pensacola

Max D. Holmes
Superintendent
Water Purif. Dept.
Hollandale

Frank Shocker
Asst. Supt.
Water Dept.
Jacksonville

Water Main Extension Panel

the mains and fire hydrants are transferred to city ownership, maintenance and operation. As we understand it the same applies to commercial or industrial extensions outside the city limits.

STANLEY SWEENY, Supt. at Pensacola, said that since 1949 they had a policy of requiring a deposit of $90 per housing unit to real estate developers which was gradually refunded from income from the new area. At present a development is to cost $190 per housing unit for main extension of proper size and $100 per unit is to be paid by the developer. According to the Norris method* of computing charges made for extensions these extensions should be charged for at the rate of $95.50 per unit.

W. F. SAVIDGE, Supt. at Naples, stated that they have a master plan in which the water department absorbs 20% of the cost of main extensions. In estimates the charge is $1.25 per foot for distance to nearest existing main as average cost. The minimum charge to a new customer is $1.00 per front foot plus cost of meter. Within the city $100 is the allowance to any metered customer. Anything beyond this is paid by the customer. This method makes for simple bookkeeping and has been satisfactory.

MAX HOLMES, Supt. at Hollandale, said that, in their master plan, previously 20% main extension costs had been refunded to the developer. New policy is to charge the subdivider the entire cost except for service lines. To the intracity meter rates 20% surcharge is added. It is understood that the developer will be refunded for the mains from surplus—if there ever is any.

JOE JOHNSON, presenting the statement prepared by WM. A. GLASS, Director, Water & Sewer Dept. of Miami, revealed that Miami has a master plan and policy which is rigidly adhered to. No extension is made unless the net return is to be at least 10% on the investment required. The cost of main extensions must be considered as only a part of the cost of supplying water and rendering service to new customers.

In the matter of extending mains and service to sub-divisions there is no fixed rule concerning charges. It becomes a matter of working out actual costs and rate of refunding the investment with each developer. When the gross return from water sales reaches 15% or more on the investment the water department will purchase the extension from the owners at actual cost. The water department does not retail water to any area outside the city limits but does wholesale water to other communities. All extensions, regardless of ownership must be designed and supervised by the water department.

In making main extensions, it seems to Mr. Glass all-important that the cost of supplying water to new areas must be taken into consideration in addition to just the main costs. Otherwise a water department may find it necessary to penalize the older customers through the imposition of a rate increase, made necessary as the result of over-extension of new service beyond the capacity of production and pumping. It does not appear practicable, therefore, to attempt to develop any fixed rules or formulae for arriving at a solution to water main extension problems. Local factors remain all important.

Water Rates

"WATER RATES" by Harold D. Briley and Harry E. Wild, of Briley, Wild & Associates, Engrs., Daytona Beach, Fla.

This paper comprised a report of a rate survey of Florida cities and an analysis of the results of the survey. It is not possible to do justice to the analytical efforts put into the survey and evaluation of rate structures. As is so frequently the case the rates in the smaller cities and towns were shown inadequate and far less realistic than rates charged by the larger cities.

The fire hydrant rental paid by the cities to water departments (presently averaging $38/year/hydrant) has been increasing while getting meters placed in public buildings has been decreasing in prevalence. It seemed evident that rate making deserves more attention in Florida, as elsewhere, as an engineering problem.

Iron Removal Practices

"MODERN IRON REMOVAL PRACTICES" by Eskell Nordell of the Permatit Co., N.Y. City, was presented by Thos. Charbonneau, Jacksonville representative of the same company.

After reviewing the several forms in which iron is found in natural waters he said that the most common iron compound is ferrous bicarbonate found in well waters and the least difficult to remove by aeration, line precipitation, filtration or zeolite filters. Chlorine is often helpful for complete oxidation of the iron. Aerators of the spray and slat-tower type are the most common. Next comes the coke-tray aerator such as employed by Memphis, Tenn., without further treatment other than filtration. In this process the pH must be lowered to between 7.5 and 7.8 for effective results.

Not uncommon is the combination of iron removal and softening with zeolite units. The iron is removed from all of the water and only a portion is softened to zero hardness for mixing with the unsoftened portion to produce the desired softness of the mixture.

When iron is in organic combination the problem is more difficult, requiring coagulation in addition to aeration and filtration. In such case the addition of activated silica is frequently helpful.

Keeping 10,000 Bosses Happy

"HOW TO KEEP 10,000 BOSSES HAPPY" is the problem of LOIS JORDAN SCHULZE and others of the headquarters staff of AWWA.

Mrs. Schulze, in her first public speech as Membership Secretary of AWWA, told of the many activities in the headquarters office. She highlighted some of the problems of her job, such as keeping abreast of changes in members' addresses, supplying back copies of the Journal to those who move, etc. The major job was that of changing addresses and deciphering hand written names and addresses.

*The Norris method is set forth in the 1953 Reference & Data Edition of Water & Sewage Works. Mr. Norris, at the time Manager of the Birmingham, Ala., system, is presently Genl. Mgr. of the Indianapolis Water Co.—Ed.

WATER WORKS PRACTICES

Source of Supply

Part 5—Well Capacity and Development

The Ninth of a Series

by GEORGE E. SYMONS, Ph.D., Consulant & Technical Editor, Larchmont, N.Y.

THE subject of Source of Water Supply encompasses these aspects: Surface Water, Ground Water, Impounding Reservoirs, and Wells. The first three topics were presented in earlier lectures in this series. The latter topic was begun in the previous lecture on the "Location and Construction of Wells"; it is continued here with a discussion of "Capacity and Development" and it will be completed in the next lecture on "Well Pollution, Operation, and Maintenance."

This article is one of a series on the general subject of "Water Works Practices," developed by Dr. Symons in the simple style of a short course lecture and designed to be of interest to small plant operators, new operators, students and any others who may wish to review the fundamentals of the subject.—*The Editors*

A. . . . Capacity

1. Ground Water Flow

a. Ground water may travel many miles before it reaches the point where it is tapped. Fifty miles is not unusual, and in the Dakota limestone, travel of 300 miles occurs.

b. Rate of flow (velocity) depends on gravity and is affected by friction.

(1) Gravitational force pulls water from one elevation (where it enters the earth or the aquifer) to a lower level. The line of the surface of the aquifer (sometimes called the static surface or static level) from one point to another lower point is called the *hydraulic grade*. The steeper the slope of the hydraulic grade, the greater the velocity of flow, other conditions being equal. In shallow aquifers, the hydraulic grade generally follows the ground surface more or less.

(2) Friction, which retards flow, is caused by the tendency of water to adhere to solid surfaces.

———The amount of friction is directly related to the surface area which the water must pass; the finer the particle size the greater the surface area exposed in any volume of spherical particle and therefore the greater the friction and hence the lower the velocity of flow.

———Friction factors are expressed in terms of *porosity* of the stratum and effective size of the particles in the stratum. Porosity is a measure of the voids in the stratum, or $e/1+e$, where e equals the void ratio, which is the volume of the voids divided by the volume of the solid particles in a unit volume. Porosity is generally in the range of 30 to 50 per cent.

———*Effective size* is that size of particle that represents 10 per cent of the total weight of all particles in the soil (that is, 90 per cent by weight, of the particles are larger than that size and therefore remains on a screen in a screening test).

———Internal friction, or *viscosity*, of the water also affects the rate of flow. This factor depends primarily on temperature. Ground waters generally have an average temperature a few degrees Fahrenheit above the annual average air temperature for the region. If the velocity of flow is taken as 1.0 at 60°F, the relative rate of flow at other temperatures will be 73 per cent at 40°F, 86 per cent at 50°F, and 115 per cent at 70°F.

(3) Thus it is seen that the velocity of flow is dependent on hydraulic grade of the aquifer, and the porosity and effective size of the soil.

———In general, hydraulic grades may be from 10 to 20 ft per mile. Velocities of 30 to 60 ft per day have been observed in gravels where the hydraulic grade is between 5 and 10 ft per mile. In coarse gravel, velocities of 400 ft per day have been observed. In water bearing sandstone,

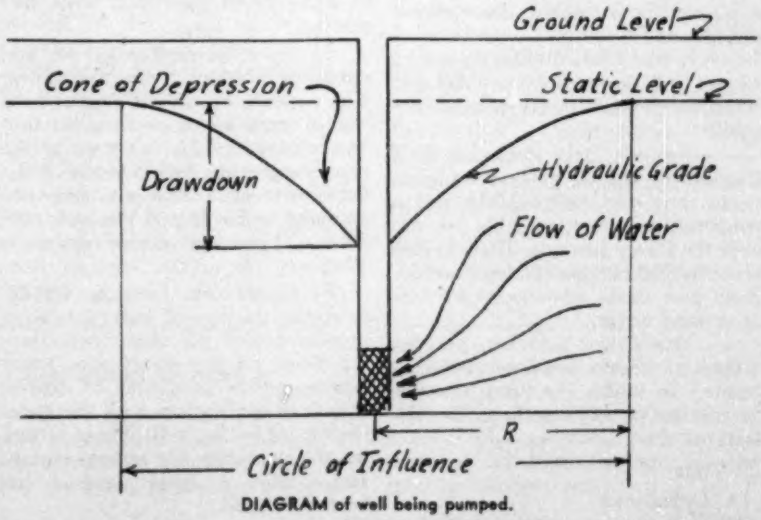


DIAGRAM of well being pumped.

SURGING tools for developing rock wells.
Plunger and upper section of cage with hook wall packer

the velocity may be as low as 50 ft per year.

c. *Permeability* is a measure of the horizontal rate of flow in gallons per day per square foot of vertical cross section. The simplest equation for determining permeability is called Darcy's Law:

$$P=ksc$$

where, P is gal per day per sq ft, k is a velocity coefficient in ft per day (or per min), s is the slope of the hydraulic grade, and c is a constant to convert cu ft to gal.

———If total quantity of water flow in an aquifer is desired, the equation becomes

$$Q=AP \text{ or } Q=kAsc$$

where, Q is the total gal per day and A is the cross-sectional area of the aquifer.

———Seelye's Data Book for Civil Engineers, Vol. 1, gives a table on voids ratio and permeability and a temperature correction table for use with the Darcy formula. Engineering texts by Babbitt and Doland and by Steel give tables on velocity of flow of ground water.

———Darcy's law holds true for conditions of stream line flow (non-turbulent) in which the head loss due to friction varies directly as the velocity of flow.

2. YIELD

a. Definitions

(1) Yield is the maximum output of water that can be obtained indefinitely from a well; *pumpage* or *production* is the amount obtained in a limited time. It is common practice to speak of the yield of a well in gal per min.

(2) The *static level* is the elevation at which water stands in a well before pumping. When a water-table well is pumped, the surface of the water outside the well casing is pulled down. The distance to which this level drops from the *static level*, during pumping, is called *drawdown*. The level of water outside the casing during pumping is called the *pumping level*. The accompanying sketch shows the pattern of flow of water to a well being pumped.

(3) Since the pumping level is below the static level, the surface of the water slopes upward away from the well toward the static level at some distance from the well. That is, the hydraulic grade assumes a slope toward the well and thus is formed an inverted *cone of depression* with the apex at the well.

(4) The base of this cone is called the *circle of influence* and represents the distance to which the well affects the aquifer. The radius of the base of the cone "R" can be determined from test wells (spaced at the apexes of a right triangle) while a well is being pumped.

———In artesian wells, although the water does not stand outside the well casing as in a water-table well, there is a drawdown from the normal static level in the well and in effect, there is a cone of depression and circle of influence during pumping.

(5) Interference of wells occurs when wells are spaced closer than a distance of 2R. Best yields from a well field are obtained when the circle of influence of individual wells just overlap.

(6) Since the yield in gal per min varies in relation to the drawdown, it is possible to express output of a well in terms of gal per min per foot of drawdown. This is known as the *specific capacity*. For example, if the drawdown of a well on continued pumping is 50 ft and the well produces 500 gpm, the specific capacity is 10 gpm.

(7) Equilibrium formulas for determining the flow of water into wells in accord with the above definitions are based on the theory that water flowing into a fixed cone of depression is in equilibrium with the water discharged by the well. These formulas are inaccurate for several reasons and a more practical approach has been developed.

b. Non-equilibrium Concept (after Steel)

(1) In any aquifer, not tapped by wells, equilibrium exists between discharge to natural bodies of water from the aquifer and the recharge rate.

(2) Withdrawal of water by wells upsets the natural equilibrium. The recharge must be increased, the hydraulics of the aquifer will change and/or the static level of the aquifer will drop.

(3) The cone of depression will gradually increase to the limits of the aquifer, although the effect beyond the normal circle of influence will be slight.

(4) Much of the water pumped from a well over a long period of time will come from storage in the aquifer. In short, the cone of depression will enlarge and become permanent and the water-table level will drop.

(5) Based on this theory, a formula has been developed to determine the drawdown from data on the discharge and the coefficient of transmissibility (permeability multiplied by depth in feet) and the coefficient of storage. (See Steel: *Water Supply and Sewerage*, pp. 63ff). This formula is useful in predicting well field yields.

(6) The non-equilibrium formu-

SURGING tools for developing rock wells.
Bottom section of Cage and Sealing Nipple, with trap for removing loosened debris.

la may be applied to artesian wells since the storage factor represents water released from storage by compression of the aquifer.

B. . . . Development

1. DEFINITIONS

a. *Development* is the term applied to methods for increasing the yield of a well when it is constructed.

b. *Maintenance* is the term applied to procedures for maintaining or restoring capacity or production of a well that has decreased in output over a period of use. These procedures are discussed later.

c. Some engineers do not distinguish between the two terms, but use "development" to apply to increasing the output of both old and new wells.

2. SAND WELLS

a. Sand and drilling mud in the vicinity of the screen will tend to clog the screen openings, either by plugging or by bridging, thus reducing the flow of water into the well.

b. *Surging* is the common method for removing this unwanted material. The water is caused to flow rapidly from the well into the ground to dislodge the particles. The well is then bailed out or pumped to remove the dislodged matter. Surging is accomplished by:

(1) Discharge of water under pressure into the well.

(2) A plunger, just slightly smaller than the diameter of the pipe is attached to the well rig, lowered into the well below the water level and moved violently up and down. (A check valve in the plunger will permit forcing the water through the screen in one direction.)

(3) Compressed air can be introduced into the well if the top of the casing is sealed. Pressure applied and released will cause surging.

(4) Dry ice (50 to 500 lb) dropped into the water with the casing sealed will vaporize quickly when it reaches the water and create a strong pressure. Inherent problems in this method require safety precautions.

(5) Gravel wall wells do not require surging since the soil particles are removed before the screen and gravel are placed.

3. ROCK WELLS

a. Wells drilled into sandstone may have their yield increased by development.

WALL BRUSH for developing rock wells

b. Methods of improving production capacity of rock wells include:

(1) Scrubbing with a specially constructed steel brush. (See accompanying illustration.)

(2) Surging with a special type of plunger which operates within a cage, the bottom of which is a basket to catch the loosened material and with provisions for sealing off both the bottom and top of the cage so that the surging action occurs within the 20 ft length of the cage. (See accompanying illustration.)

———The well is bailed out after each surging operation and the cage raised another 20 ft. As much as four cu yd of sand clay and rock have been removed in the development of a 12 in. well, 350 ft deep.

(3) Blasting is used in consolidated material where crevices can be opened by the shock of the blast. (Blasting cannot be used in sand or gravel wells, as it may cause a packing of the particles.)

———For blasting treatment, speed, high power, low bulk and certainty of explosion are the necessary characteristics of the explosive used. Fifty to 200 pounds of 80 per cent gelatin and nitroglycerine may be used or, for small charges, 40 to 60 per cent dynamite.

———Usual procedure is to begin with small charges and increase the size of the charge; bailing out the well after each shot, until no more debris is removed.

4. COSTS

a. The cost per foot of depth of a well may be increased by as much as 60 per cent by development (particularly in rock wells) and the time required for development may be as long as the drilling time.

b. Development, however, reduces the cost of the well per gallon of water delivered by as much as 15 per cent. Furthermore, additional important savings are realized by the reduction in number of pumps, pump houses, piping, wiring, etc., necessary to deliver the amount of water required.

5. QUALITY

a. In general, ground water is clear, cool, and free from bacteria; characteristics which make it desirable for domestic and industrial use.

b. It may contain undesirable substances dissolved in it; particularly, carbon dioxide, hydrogen sulfide, and the salts of iron, maganese, calcium, and magnesium, or undesirable amounts of sodium salts.

c. If any of these substances are present in excessive amounts, the water will require treatment for their removal or reduction in concentration, before use.

d. Contamination of well waters may be caused by sewage, industrial waste, incinerator ashes, and salt water intrusion.

C. . . . Reference Material

Material for this lecture was based on the current water works literature and the following engineering texts:

Babbitt & Doland—"Water Supply Engineering" (McGraw-Hill)

Bennison—"Ground Water, Its Development, Uses, and Conservation" (E. W. Johnson)

Hardenbergh—"Water Supply and Purification" (International Textbook Co.)

Steel—"Water Supply and Sewerage" (McGraw-Hill)

NEXT LECTURE

WELL POLLUTION, OPERATION and MAINTENANCE.

Village May "Import" Canadian Water

The Minnesota village of Ranier is studying a plan for an "international" water system.

Ranier has no water distribution system of its own and wants to "import" water from Fort Frances, Canada, by running a pipeline under Sand Bay on Rainy Lake. The water then would be supplied by the Fort Frances pumping station.

The Ranier and Fort Frances city councils plan to meet to discuss the proposal, although no date for the meeting has been set.

LAYING 30" Lock-Joint Concrete Intake in China Lake

Water and Sewage Improvements at Waterville, Maine

Theme of Winter Meeting of Maine Water Utilities Association

As reported by
J. ELLIOTT HALE, Superintendent,
Kennebec Water Distr., Waterville, Me.

THE winter meeting of the Maine Water Utilities Association was held at Waterville, Maine, on December 9th, 1953. Over 130 members and guests were present.

In the morning the assembled water works group inspected the Pumping Station and Service Building of the district, where they had an opportunity to see a spic and span pumping station and service building, up to date service equipment and meter repair room.

Mayor, re-elect, Richard J. Dubord welcomed the group to Waterville, the birthplace of the Association. He spoke of the passing of Harvey D. Eaton, "father" of the Maine Water District idea, which has been copied all over the country.

More Water for the District

J. Elliott Hale, Supt. of the Kennebec Water District described in detail the improvements made to the District's system. One was a new 30" transmission line of Lock Joint prestressed concrete cylinder pipe, extending from the North Vassalboro pumping station to China Lake a distance of 15,000'. The new line was laid parallel to and on the same grade as the existing 24" line which was laid in 1904 and 1905. The effect of this new line was to bring China Lake, the source of supply, to the North Vassalboro station where more than 16 mgd are now available for use by the District, the previous amount being only 6.2 mgd.

Considerable ledge was encountered during the laying of the new line, and several swamps and streams were crossed. There were no special difficulties encountered in the entire job and the contractor is to be congratulated for a fine job as it was his first experience with Lock Joint concrete pipe.

New Intake Building and Intake Line

With the construction of the new 30" transmission line it was necessary to build a new Intake Building on the shore of China Lake at the site of the present intake building. It is of brick construction with a concrete screen and intake well. The new unit was built around the existing intake chamber. Both units act independently of each other, but the two transmission lines are jointed at the North Vassalboro pumping station.

The screens are removed by an electric hoist for cleaning, and then taken out of doors on an overhead trolley to be washed and cleaned. Water under pressure is provided for washing the screens. The new intake building and equipment are modern and consistent with the work to be done.

The new intake line consisting of 30" subaqueous concrete Lock Joint pipe extends out into China Lake about 512' to a depth of 16' over the invert of the last section of pipe.

The end of the pipe rests on a concrete cradle which is 8-feet long, 4-feet wide and 3-feet high with a 45° bend looking up. A round brass screen is fastened to this 45° bend.

The screen is made of 1" x ¼" brass bars and spaced 1" apart, and serves as protection for the screens in the Intake Building.

Each section of pipe was laid on a pier of sand bags which extended several feet on each side of the joint for additional support to the pipe section The entire line was backfilled with sand and fine gravel, with the coarser material taken from the excavation placed on top. The entire line was inspected by a diver before acceptance by the District.

Mr. Hale showed slides of the construction and also of the construction of the original intake line in 1904-5. Slides were also shown of the repairing of a break in the 24" line under Outlet Stream which occurred during the laying of the new pipe line.

A transverse crack appeared near a joint of the 24" line. This was stopped by using a home-made sheet copper

TAPPING 24" line for 16" connection, and 30" Lock-Joint pipe distributed along right-of-way

and rubber gasket clamp similar to that made by the Smith-Blair Co.

The cost of the three projects was about $321,000.

Waterville Cleans up The Messalonskee

Paul Howard of Whitman and Howard, Engineers, Boston, Mass., presented an excellent paper explaining the construction of a new sewage interceptor along the shore of Messalonskee Stream.

Further development of the western section of Waterville had been restricted due to a state law prohibiting the discharge of additional sewage into the stream. The city decided to do something about it. A Sewerage District was chartered by the Legislature, and Whitman and Howard were engaged as engineers with Sam Aceto of Portland doing the actual construction.

The interceptor extends from the cedar bridge on upper North Street to a point about ¼ mile above the confluence of the Kennebec River and Messalonskee Stream.

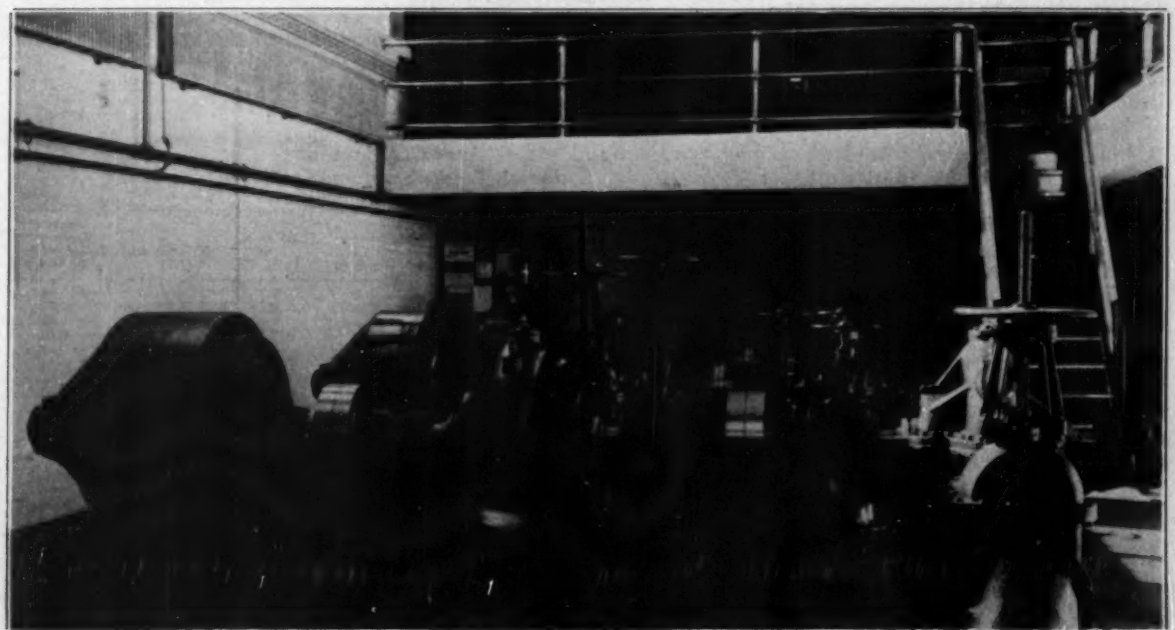
As the name implies, the interceptor follows along the bank of Messalonskee Stream to pick up the various sewers that emptied into the stream and to make provision for new sewer connections.

For a distance of a mile the interceptor is built into Messalonskee Stream due to ledge construction and the fact that the right of way for the 24" transmission line of the Kennebec Water District follows along the west bank of the stream.

At one point, where the interceptor goes around a series of dams, it was necessary to construct a tunnel. Special manholes were constructed to divert excessive storm flows from the interceptor to Messalonskee Stream.

Several branch sewer lines were installed to provide more adequate facilities for draining certain areas which, after each storm, were always flooded. Fully 50% of the sewage from the city is now intercepted by this new sewer and development of the western section of the city is no longer restricted, furthermore a badly polluted stream has been cleaned up.

The construction of this interceptor was the major stream improvement project in the state of Maine in 1952-1953. Total cost of the completed project was about $650,000.



PUMPING Station (Western Ave.) of the Kennebec Water District

Determining Residual Chlorine in Water by Neutral Ortho-Tolidine Methods

A Progress Report

by **A. T. PALIN**, *Chief Chemist, Newcastle and Gateshead Water Co. Newcastle upon Tyne, England*

EXPERIENCE in the application of the ferrous ammonium sulphate—neutral o-tolidine method [1,2] to natural waters, coupled with continued laboratory investigation, has led to the adoption of a few minor modifications and to the development of an improved procedure for the determination of nitrogen trichloride.

Also available is a colorimetric version of the method using permanent glass colour standards [3] and incorporating a colour-stabilizer as developed by Aitken and Mercer.[4] The present paper, however, is concerned only with the volumetric technique which in England is being currently considered for official adoption as a "recommended procedure."

This technique is presented in full on the facing page.

Free Chlorine and Monochloramine

Decolourization of the blue meriquinone colour by added ferrous ammonium sulphate is not quite instantaneous. For this reason it was necessary to specify a waiting period of 15 seconds between additions of standard solution near the end points. The reaction rate, however, can be considerably accelerated by increasing the hexametaphosphate concentration in the colour mixture. In the modified buffer reagent now used the amount of hexametaphosphate has been increased from 2% to 10% (w/v).

With a more rapid titration, the fading errors previously encountered at unusually high temperatures become less significant, and for temperatures not higher than 20°C may certainly be counted negligible.

Dichloramine

The strength of the sulphuric acid reagent used for pH depression in determining dichloramine has been increased from 5% to 6% (v/v) to allow for the increased amount of hexametaphosphate in the colour mixture.

The ferrous ammonium sulphate method as given is normally capable of determining available chlorine concentrations of up to 8 ppm. It has been found desirable, however, to limit the maximum amount of dichloramine that may be determined (without dilution of sample) to 4 ppm.

The action of the potassium iodide in activating the chloramines appears, at any rate in part, to be catalytic but it has been observed that the amount specified (equivalent to 4.3 ppm available Cl_2) is hardly sufficient to ensure under all conditions a complete colour reaction between the o-tolidine and amounts of dichloramine over about 4 ppm. The resulting deficiency, although not serious at about 5 ppm, could amount to a 0.5 ppm deficiency in the vicinity of 7 or 8 ppm dichloramine concentration. In such cases dilution of sample is now recommended in preference to increasing the concentration of potassium iodide.

With these higher concentrations of dichloramine it was also noted that the effect of increased hexametaphosphate concentration on the speed of titration was not nearly so marked as was the case with the free chlorine and monochloramine fractions. During further investigation it was discovered that adding the ferrous ammonium sulphate at the acid stage of the dichloramine procedure gave instantaneous decolourization when, and not until, the sodium bicarbonate reagent was added for the purpose of returning the pH to near neutral.

For speedy titration of dichloramine, therefore, the aim should be to add as much as possible of the required amount of the standard ferrous solution while the colour mixture is still acid. A procedure has been developed by which the colour of the acidified solution provides an indication of the amount of standard solution that may safely be added without finding the end point overshot on the subsequent addition of sodium bicarbonate.

Nitrogen Trichloride

Both nitrogen trichloride and free chlorine appear in the first fraction of the ferrous ammonium sulphate method and for their differentiation and extraction procedure was originally developed in which use was made of the solubility of NCl_3 in carbon tetrachloride.

In more recent work the addition of about 10 ppm ammonia-nitrogen (added as NH_4Cl) was found, at the pH given by the buffer solution, to convert any free chlorine practically instantaneously into monochloramine (with lesser amounts of dichloramine); so leaving only NCl_3 to appear, on the addition of neutral o-tolidine, in the first fraction reading.

Table 1

AVAILABLE CHLORINE

Comparable Results by Neutral Ortho-Tolidine and by Acid Thiosulfate

Sample No.	By Ferrous Ammonium Sulphate				By Acid-Thio	Difference	Apparent % Recovery of NCl_3 by F.A.S.
	Cl_2	NCl_3	$NHCl_2$	Total (F)	Total (T)	(T-F)	
1	0.3	2.7	0.8	3.8	6.1	2.3	54
2	0.1	1.2	3.5	4.8	5.7	0.9	57
3	0.1	0.9	3.3	4.3	5.0	0.7	56
4	0.4	1.5	0.3	2.2	3.4	1.2	56
5	0.6	2.1	0.1	2.8	4.6	1.8	54
6	0.6	1.8	0.1	2.5	4.1	1.6	53
7	0.9	5.1	0.3	6.3	10.8	4.5	53
8	0.5	1.6	0.3	2.4	3.7	1.3	55
9	0.3	1.6	0.3	2.2	3.4	1.2	57
10	0.6	2.3	0.2	3.1	5.2	2.1	52
11	6.3	0.7	0.3	7.3	7.9	0.6	54
12	8.3	0.4	0.0	8.7	9.0	0.3	57
13	4.5	3.6	0.2	8.3	11.5	3.2	53
14	3.6	3.8	0.2	7.6	10.7	3.1	55
15	4.0	3.9	0.2	8.1	11.4	3.3	54
16	4.0	3.7	0.2	7.9	11.0	3.1	54
17	4.9	2.5	0.1	7.5	9.5	2.0	56
18	3.9	2.8	0.2	6.9	9.1	2.2	56
19	4.6	2.7	0.2	7.5	9.6	2.1	56
20	4.6	1.7	0.1	6.4	7.8	1.4	55
21	4.8	0.4	0.1	5.3	5.6	0.3	57
22	0.2	1.3	0.4	1.9	3.0	1.1	54
23	0.3	1.6	0.6	2.5	4.0	1.5	52
24	2.7	1.5	0.1	4.3	5.5	1.2	56
25	0.6	2.6	0.7	3.9	6.1	2.2	54
26	0.4	1.7	0.2	2.3	3.8	1.5	53

Improved Volumetric Technique for the Determination of Free Chlorine, Monochloramine, Dichloramine and Nitrogen Trichloride in Water

(PALIN METHOD)

1. Reagents

1. Buffer Solution.
   12 gm. anhydrous Na_2HPo_4, A.R.*
   60 gm. KH_2PO_4, A.R.
   100 gm. sodium hexametaphosphate, B.D.H.‡
   Dissolve in distilled water and make up to 1000 ml. (Mould growths may be prevented by the addition of 20 p.p.m. $HgCl_2$).
2. Neutral Ortho-Tolidine Solution.
   Grind 1 gm. extra pure o-tolidine, B.D.H., in a mortar with 5 ml. 20% v/v HCl to a thin paste. Dissolve in Cl_2-free distilled water and make up to 1000 ml. Store in amber bottle.
3. Potassium Iodide Solution, 0.2%.
4. Sulphuric Acid Solution, 6% v/v.
5. Sodium Bicarbonate Solution, 5%.
6. Standard F.A.S. Solution. (1 ml. = 0.1 mg.Cl.) Dissolve 1.106 gm. ferrous ammonium sulphate, A.R., in distilled water containing 1 ml. of 25% v/v H_2SO_4 and make up to 1000 ml. Use freshly-boiled and cooled distilled water.

2. Procedure

1. Free Chlorine.

Place 5 ml. each of reagents 1 and 2 in titration flask and mix. Add 100 ml. sample and mix. Titrate with standard F.A.S. solution until blue colour is discharged (Reading 1).

2. Monochloramine.

Add 1 ml. reagent 3 and mix. Continue titration until blue colour is again discharged (Reading 2).

3. Dichloramine.

Add 1 ml. reagent 4, mix and stand about 1 min. Then add 5 ml. reagent 5 and mix. Continue titration (Reading 3). (See note 4 below).

4. Results.

(As available chlorine p.p.m.)

Reading 1 gives free chlorine
Reading (2 — 1) gives monochloramine
Reading (3 — 2) gives dichloramine.

3. Notes

1. As the end points are approached allow about 5 seconds between additions of standard solution.
2. To avoid errors due to fading it is advisable to carry out titrations at a temperature not greater than 20°C.
3. If the total available chlorine exceeds 8 p.p.m. or if the dichloramine itself exceeds 4 p.p.m. it is necessary to take a smaller quantity of sample. The distilled water used for dilution to total volume 100 ml. should be added and mixed with reagents 1 and 2 before adding the sample.
4. It is an advantage when titrating dichloramine to add as much as possible of the required amount of F.A.S. solution while the colour mixture is still acid and before the final neutralization with sodium bicarbonate. The colour of the solution at this stage may be used as a guide to the amount of F.A.S. solution that may safely be added without finding the end point overshot when the colour mixture is brought back to neutral pH. Thus:

Colour	Add mls. F.A.S. soln.
yellow	none
brown	0.5
purple	1.0
blue	1.5
green	2.0
dark green	3.0

4. Additional Procedure for Nitrogen Trichloride

Nitrogen trichloride, the presence of which will usually be indicated by its distinct odour, gives a colour which appears in fraction 1 with free chlorine. The result obtained in titrating this colour corresponds to only half of the nitrogen trichloride present.

1. Method A.

Remove the nitrogen trichloride by extraction of a portion of the sample with one-tenth as much carbon tetrachloride, A.R. After separation add 100 ml. to the aqueous layer to titration flask containing 5 ml. each of reagents 1 and 2. Titrate as before (Reading 4).
Reading 4 now gives free chlorine.
Reading (1 — 4) x 2 gives nitrogen trichloride.

2. Method B.

Additional Reagent:
Oxalic Acid solution 2%, (20 gm. $(COOH)_2$ $2H_2O$ A.R. dissolved in distilled water and made up to 1000 ml. Store in amber bottle).
Procedure.
Place 5 ml. reagent 1 and 5 ml. oxalic acid solution in titration flask. Add 100 ml. sample, mix, and stand 15 mins. Then add 5 ml. reagent 5 and 5 ml. reagent 2. Titrate as before (Reading 4).
Reading 4 x 2 gives nitrogen trichloride directly.
Reading (1 — 4) now gives free chlorine.

5. Interfering Substances

The only interfering substance likely to be encountered in water is oxidized manganese which gives a colour in the free chlorine fraction. If it is necessary to allow for this interference, proceed as follows:
Place 5 ml. of reagent 1, 1 ml. of reagent 3 and 0.5 ml. of 0.5% sodium arsenite solution. ($NaAsO_2$) in titration flask. Add 100 ml. sample and mix. Then add 5 ml. reagent 2 and mix. Titrate any blue colour with the standard solution. This reading is subtracted from Reading 1.

* A.R.—Analytical Reagent.
‡ British Drug Houses Ltd.

An even better procedure, however, is to use oxalic acid which, in destroying free Cl_2 and leaving NCl_3, also provides a very simple method of differentiation. These methods have the advantage that, unlike the extraction procedure, the NCl_3 (usually present in only small amounts relative to free Cl_2) is now determined directly instead of by difference. A disadvantage of the ammonia differential technique is that with a high free Cl_2 content in the sample a considerable amount of monochloramine is formed and this tends to blunt the end point when determining the relatively small residual of NCl_3 remaining in the first fraction.

In the earlier work it was shown that not all the available chlorine of nitrogen trichloride was recovered in the neutral o-tolidine method. To obtain agreement with parallel acid-thio titrations an empirical factor of 1.5 was introduced.

The new oxalic acid procedure has permitted a more accurate determination of this factor and it is now found to lie between 1.8 and 1.9; that is to say the apparent recovery of NCl_3 by the ferrous ammonium sulphate method is about 55% instead of the 67% previously accepted. In support of this new factor some experimental results are presented below.

In this recent work not only was an improved analytical technique used but the samples were so prepared as to contain considerably increased proportions of NCl_3 than was the case in the original work. While it is unlikely that such amounts of NCl_3 would ever be encountered in practice it has enabled a more accurate assessment of the nitrogen trichloride factor to be made (see Table 1).

These results give an average figure of 54.7% for apparent recovery of NCl_3 by the ferrous ammonium sulphate method.

Various concentrations of oxalic acid were tried experimentally during the above tests and in each case the optimum contact period for Cl_2-NCl_3 differentiation was determined by appropriate preliminary tests. It was also thought desirable to include a small amount of Calgon (usually about 1%) in the oxalic acid reagent to prevent calcium precipitation when applying the tests to hard waters.

Another way of avoiding such precipitation is to add the normal buffer reagent, which contains Calgon, to the sample with the oxalic acid and this procedure was, in fact, eventually adopted. Using a 2% oxalic acid solution and adding 5 ml. to 100 ml. of sample with the normal amount of buffer reagent it was found that a suitable period of standing at room temperature for free chlorine removal was 15 minutes.

In experiments with NCl_3 Dowell and Bray[5] investigated its reduction by KI in acid solution and their results appear to have been interpreted by some as showing the starch-iodide titration to include only about 80% of the NCl_3 present.

The original work of Dowell and Bray would seem to suggest that the deficiency is not 20% but only 9%. It was established that the main reaction in the reduction of NCl_3 involved 6 equivalents of reducing agent per mol. of NCl_3 and gave ammonia or ammonium ion as the final product, but the simultaneous formation of nitrogen was also observed in most cases as a result of a side reaction involving only 3 equivalents of reducing agent per mol. of NCl_3.

In the particular case of reduction by KI, in the presence of sulphuric acid, about 18% of the nitrogen in NCl_3 was transformed into N_2 and this figure was found to be practically independent of the concentration of acid or KI—the latter being present always in excess.

Although 18% of the NCl_3 follows the side reaction this reaction still involves 3 equivalents of KI per mol. of NCl_3 (that is, half the normal amount) and it may, therefore, be concluded that the actual percentage of NCl_3 recovered in the acid-thio titration is 91% and not 82%.

Nitrogen Trichloride Correction Factor

It was then decided to investigate the relationship between this figure and that returned by the ferrous ammonium sulphate method when (compared against an acid thio reading uncorrected for NCl_3 deficiency) which averaged out to the apparently inexplicable figure of 54.7%.

For this purpose it is convenient to consider the case of a solution containing only NCl_3. If T = the apparent acid thio reading and F = the apparent ferrous ammonium sulphate reading then

$$T = \frac{100}{54.7} \times F$$

$$\text{True Reading} = \frac{100}{91} \times T$$

$$= \frac{100}{54.7} \times \frac{100}{91} \times F$$

$$= 2.01\ F.$$

From this result it is now concluded that the correction factor to use in determining NCl_3 by the ferrous ammonium sulphate method is 2.0. This revised figure, therefore, follows a more accurate determination using the new oxalic acid procedure coupled with the decision to make allowance for the known deficiency of the standard acid thio titration in determining NCl_3.

That proportion of the NCl_3 which apparently is unreacted in the first fraction *does not* subsequently appear at any later stage of the procedure.

References

1. Palin, A. T., Jour. Inst. of Water Engrs., 1949. *3*. 100.
2. Palin, A. T., Ibid., 1950. *4*. 565.
3. The Tintometer Ltd., Salisbury, England (Lovibond Comparator Handbook, Part 3, Section 25).
4. Aitken, R. W. & Mercer, D., Jour. Inst. of Water Engrs., 1951, *5*. 321.
5. Dowell & Bray, Jour. Amer. Chem. Soc. 1917, *39*. 896.

"Firemen, Spare That Flame!"

If you have a waste gas burner operating at your sewage plant maybe you'd better hide the flame from the local fire department because here is what has happened to at least one waste gas burner.

Just before Christmas we received the following interesting account of the fire-fighters rushing into one of the sewage plants of the Hampton Roads Sanitation District and putting out the waste gas flame. From Frank Miller, the Commission's chief engineer, comes the following account of the incident:

"Last night far into the morning the plant operator was disturbed in his normal duties by the wailing of sirens and the clanging of bells all over the place. After rushing around the plant he finally saw several pieces of fire equipment pull into the plant area and he himself rushed out to see what was going on. It developed that an alarm had been received and, we being in an industrial area, the heavy equipment had been ordered out and had done a very prompt and effective job of fire control on, of all things, our waste gas burner. One thing that adds to the humor of the situation for us is that the digestor had the burps with no gas for almost two years and it is only in the last about 30 days that we have been able to confiscate enough gas to keep the flame going. Then, some eager beaver sends the whole fire department to get it under control."

We understand that it wasn't easy to get the burner going again, even with the aid of the fire fighters embarrassed by their mistake.

The Mobilization Readiness Program

THE water and sewage works official is well aware of the every day importance of his facilities to the health and well-being of the Nation. During a period of national emergency, these facilities assume an even more important role—one which demands accurate and up-to-date knowledge of material needs to enable the facilities to continue and to furnish essential support to a full mobilization effort.

Requirements Must be Evaluated

The mobilization readiness program, a study approved by the President, has been undertaken by the Office of Defense Mobilization with assistance from other federal departments. The plan is to determine and allocate the nation's maximum production potential under full mobilization conditions so as to obtain the greatest national security from our resources. In this study it becomes necessary to evaluate full mobilization requirements for all sectors of the economy.

Resources are Manpower and Materials

The mobilization readiness plan now under study is made on the premise that the fundamental governing factors which limit production are our resources in manpower and basic raw materials. Any war in which we may become engaged will be fought with reserve stocks accumulated in advance, with production capacity in place on the day hostilities start, and with capacity that can be created during the conflict.

Material Requirements Must be Specific

Based on a preliminary calculation of the nation's aggregate maximum ability to produce goods and services of all kinds, a rough division of total resource capability is made among the major categories of military and essential civilian programs. The department with responsibility for each of these programs then proceeds to develop optimum production and construction schedules and translates these into requirements for detailed materials, which are then aggregated and compared with anticipated national supplies. Specific unbalances which are revealed by this process may be reduced to a minimum by redistributing resources or liquidating deficiencies where possible.

This current and timely statement has been prepared for *Water & Sewage Works* by Mr. John H. Ludwig, Div. of Water Pollution Control, U.S. Public Health Service, Washington, D.C.

Water and Sewerage Needs

Water supply and sewerage are essential civilian programs and must be evaluated as to materials needs in order to insure adequate facilities for the protection of the nation's health and to provide adequate water supply or waste disposal facilities for industrial establishments served by municipal systems.

Two Agencies are Involved

Responsibility for developing mobilization requirements for public water and sewage and waste facilities including all water wells was assigned by the Office of Defense Mobilization on January 29, 1952 to the Department of Health, Education, and Welfare, Public Health Service, as the government agency with primary responsibility in these fields. This delegation was reaffirmed in a memorandum dated July 23, 1953 from A. S. Flemming, Director, Office of Defense Mobilization to Nelson Rockefeller, Under Secretary of Health, Education, and Welfare and to Craig Sheaffer, Assistant Secretary of Commerce, wherein the separate responsibilities of these two agencies were defined as follows:

"Present delegations of authority from the Office of Defense Mobilization will remain in effect. This means that there will remain in effect:

"a. The mobilization responsibilites assigned to the Department of Commerce for priorities and allocations, preparation of limitation orders, and determination of components requirements; and

"b. The mobilization responsibilities assigned to the Department of Health, Education and Welfare (Public Health Service) to determine requirements for copper, steel, and aluminum (feasibility test) required to support the water works and sewerage works industry within the demands of programs established by the Office of Defense Mobilization for hypothetical war years."

Preliminary Estimates of Needs

The first preliminary estimates of requirements by all essential civilian programs were submitted to the Office of Defense Mobilization on May 1, 1953. In the quarterly report to the President by the Director of Defense Mobilization issued on October 1, 1953, Mr. Flemming estimated that by mid-November 1953 first round studies by the military would be completed, thus allowing the first aggregation of needs for comparison with total manpower and material resources.

Current Analysis of Requirements

In the meantime the various government agencies who submitted requirements in May have been reviewing their preliminary estimates in order to improve or substantiate the mobilization needs. The Public Health Service, in making its studies in the public water and sewerage fields, is currently analyzing the present water production potential and conservation possibilities from the primary industrial communities of the nation. This is being done in order to evaluate the new construction which would be necessary to meet the needs incident to increased industrial production and population migration brought about by full mobilization. It is expected that particular attention will be devoted to all communities of 10,000 population and greater with a representative sample of those in the 5,000-10,000 population range.

Responsibilities Recognized in the Program

The success of the mobilization readiness study, the first comprehensive program of its kind ever attempted by any nation—one which for the first time recognizes that resources are the prime limiting factors in our mobilization potential—is dependent on realistic and comprehensive studies of needs for all essential programs. The public water and sewage facilities of the nation, in the role of protector of the nation's health and provider of high quality water for essential industrial production, will be burdened with heavy responsibilities during a full mobilization period whenever such a time may come. The Public Health Service feels that the first step in the preparedness program is an evaluation of present facilities to pinpoint deficiencies in relation to anticipated mobilization needs. Such a program will require the full support of water and sewage works officials throughout the nation.

Wash Water Measurement in Filtration Practice

A case for the centrifugal pump of proper characteristics

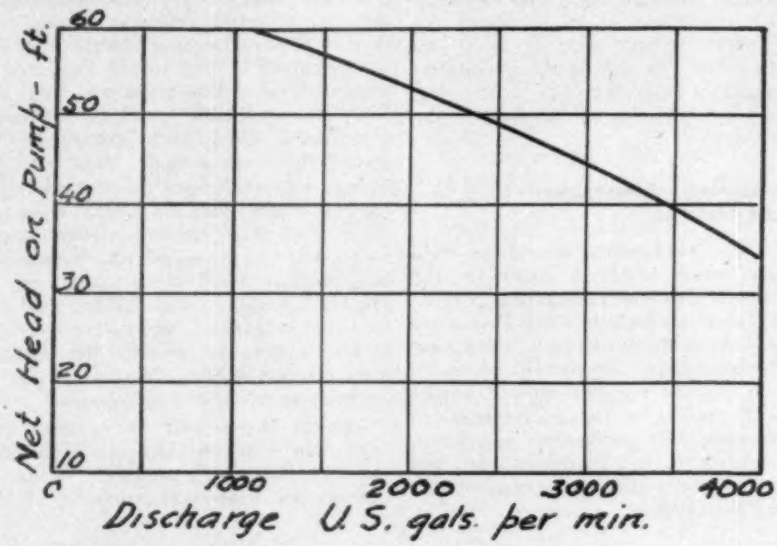
by ROBERT W. ANGUS, M.E., Consulting Engineer, Toronto, Canada

IN ALL rapid sand filtration plants the filtering material is cleaned, after a period of service, by reversing the down-flow through the filter thereby flushing the deposited matter to the drains. The reversed flow is produced by forcing wash water up through the filter beds, the necessary head for this purpose being obtained in the earlier plants (also some recent plants) from an elevated storage tank. It is, however, frequently more convenient to use low head centrifugal pumps for the purpose, since the pumps occupy little space, are usually cheaper in first cost than the tank, and have the further advantage that they produce a constant head, while that derived from a tank decreases as the tank empties. In addition, the tanks are often rather unsightly. Expensive filtered water is used for this washing process because raw water would carry pollution into the system.

Wash Water Flow Measurement

The wash water must be delivered with some care since a very high velocity may disrupt the filter bed, whereas too low a velocity may not create effective bed liquidation, or cause enough agitation to properly wash the filtering materials. It is, therefore, most desirable, perhaps necessary, to have some means of measuring the rate at which the wash water is being supplied. A rate often adopted, with sand as the filtering medium, is that which will give an upward flow over the entire bed of 24 in.-per min., but many operators use a lower rate and some use a higher rate, depending on circumstances. Measurement of the wash water presents some problems in filters of moderate or large size, because the only practical method of measuring the large flow is to apply some form of flow measuring device to the supply as it comes from the pumps or tank. The most common measuring instruments are the Venturi meter and the orifice. If reasonable accuracy is to be expected, either of these instruments must be set in a long straight pipe to produce favourable approach conditions, and the Venturi tube is in itself rather long. Fortunately, extreme accuracy is not necessary but the results should be fairly close.

To turn the matter into concrete figures, consider a filter bed for a normal delivery of 1.5 million U.S. gpd, for which the horizontal filter bed area would be 525 sq. ft. at a normal rate of filtration of 350 sq. ft. per million gpd. If an upward wash water rate of 24-in. per min. on the bed is desired then the total flow from the tank or pumps should be 1050 cu. ft. per min., which is equivalent to 7880 gpm. A 20-in. supply pipe would be suitable for this quantity, although some designers would use a different size. The length of straight pipe, including the Venturi meter tube or the orifice, necessary for accuracy, would not be less than sixteen



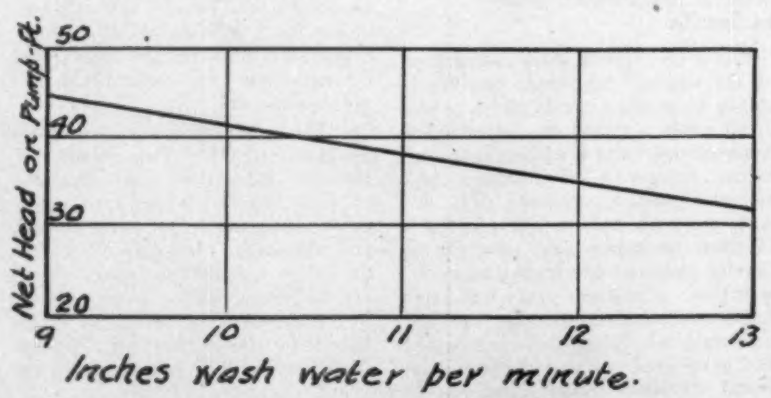


Fig. 1—(above) Head-discharge curve of pump suitable for indication and control of wash-water rates.

Fig. 2—(below) Curve for conversion of net-head on pump to wash-water rate being delivered.

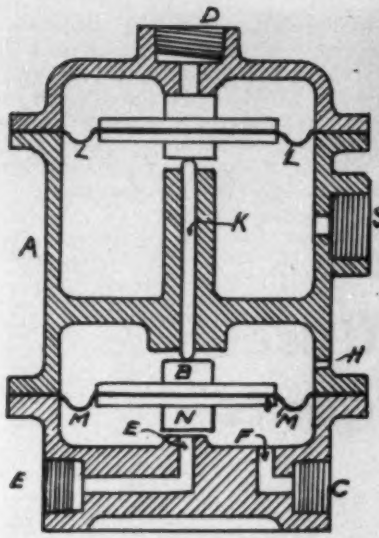


Fig. 3—Design principles of transmitter for conversion of net pumping head to washing rate.

feet and it is often extremely hard to provide for such a length.

Pumps as Flow Control and Measuring Devices

Where the wash water is delivered by pumps, these may often be used as the flow control and measuring devices with quite sufficient accuracy for the purpose. Generally the pumps are low-head, large volume, high specific speed pumps and this type of pump has a relatively steep head-discharge curve, the head at shut-off frequently being nearly twice that at rated discharge. In such pumps the discharge is quite definitely known from observing the *net head* as shown by ordinary pressure gauges. The curve for a pump now in service is shown on Fig. 1. Two such pumps in parallel would be needed for the case being discussed. At the discharge of 3940 gpm the curve shows a head on the pump of 35 ft., and if a differential gauge could be made to indicate the *net head*, then the gauge could have the 35-ft. mark replaced by a 12-in. rise per minute mark. Similarly, a 9-in. rise per minute mark corresponds to 2955 gpm and this rate of flow is produced at a *net head* of 45 ft. on the pump, so that the 45 ft. mark shown on the differential gauge would be replaced by a 9 in. rise per minute mark, and so on. The differential head gauge could, therefore, be graduated in inches of wash water rise per min. and where two pumps operate in parallel the total rise would be the *sum* of the readings of the two gauges.

Instrumentation of Net Head and Wash Rates

For the particular case referred to, Fig. 2 shows the curve connecting the *net head* on the pump with the inches of backwash upflow per minute for one pump. In this case, the curve is straight, giving uniform graduations, but where the characteristic curve does not result in a straight wash water line similar to that shown, a cam can be used to make the graduations on the instrument uniform. The accuracy of the work, of course, depends on an accurate determination of the pump characteristics and the differential gauge connections must be made at the same points on the pump as were used in testing the pump.

There are various types of differential gauges, but the one used must be sensitive and nearly frictionless. The transmitter for a differential gauge is shown in Fig. 3, and is made by Control and Metering of Toronto, Canada. However, the principle used is a very old one; it was employed many years ago in balancing the thrust of centrifugal pumps, and it has been used in various other ways.

The transmitter or differential part of the device (Fig. 3) consists of a cylinder A which need not be over 3-in. or 4-in. diameter, with two light diaphragms, L and M, inside it as indicated. The pump discharge nozzle is connected to point D while the suction nozzle is connected at S and the net pressure on the diaphragm L is the same as the net head produced by the pump. Below the upper diaphragm is a small rod K passing through a solid plate below, in which it is frictionless and leak proof, and this rod rests on the second diaphragm M at B, the latter having attached to it a round rod N with flat end which can seat itself on the top of the hole E in such a way as to close E when the diaphragm M is pressed down. Adjacent to E is another hole F connected to a convenient drain. There is a vent at H for obvious reasons. The hole E is connected by a small pipe to a source of water where the pressure exceeds the maximum head produced by the pump.

This differential transmitter is connected up as shown on Fig. 4. Where the available pressure supply for E is too high, a reducing valve R is often desirable in the line, and in the same line there must be a very small orifice O so that the flow in the line will never be very large. The flow indicating gauge G is attached to the tube E as indicated on the drawing.

Action of the Transmitter

The action of the transmitter is very simple. The net head on the pump forces both diaphragms down closing the hole E which remains closed till the pressure in E builds up enough to open it, and then the small orifice permits a small flow up through E and out the drain. Obviously, the hole at the top of E will just remain far enough open to allow the water pressure in the hole E to balance the net pump pressure acting on the upper diaphragm, in which case the pressure in E is the net pressure head on the pump, and this can be read on a gauge G attached as shown. There is constant leakage which is, however, very small and is controlled by the small orifice referred to, and both diaphragms must be sensitive to small pressure differences. The actual movement of the diaphragms is insignificant. There is a very small error in the gauge due to the unbalanced pressure on the rod

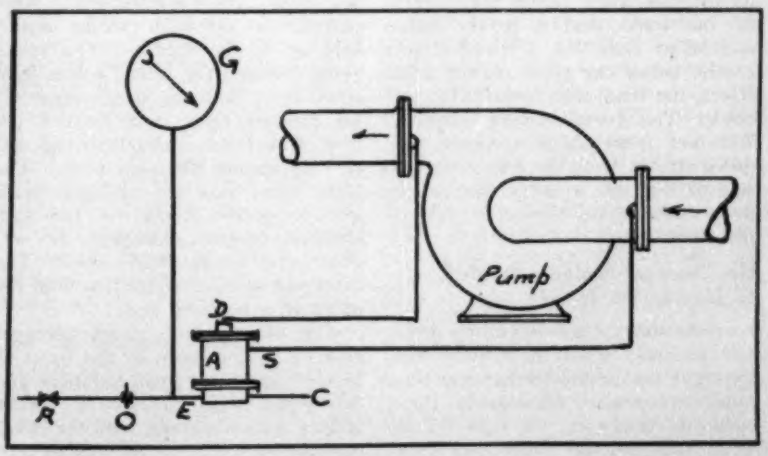


Fig. 4—Diagram of installation of net-head transmitter, showing location of instruments and connections.

K, but for this case that error is negligible.

This arrangement gives a very simple, inexpensive and sufficiently accurate method for measuring the rates of back-wash water and it will remain reliable so long as the pump is kept in good condition. It is not applicable to a pump with a flat head-discharge curve on the part of the overall curve to be used, because for a flat curve large changes in discharge correspond to very small pressure changes and the instrument is not sensitive enough to indicate pump delivery change with sufficient magnitude under such conditions. Only the pipes and valves absolutely essential are shown in Fig. 4 and gate valves would ordinarily be placed in the lines to D and S so that the gauge could be disconnected. Ordinarily all lines to and from the transmitter would consist of ⅛" copper tubing.

Water Purification Upset Seriously by Detergents

Wheeling Experience Indicates that Detergents Pose Real Problem for Water Works Men

by **A. R. TODD**, *Supt. of Water Purification, Wheeling, W.Va.*

AFTER a prolonged dry spell water purification plants along the upper Ohio River experienced a new trouble maker, and an experience that they will long remember. This new trouble maker proved to be synthetic detergents in the river water contributed by up-stream communities.

It all started the last few days in November when the countryside received the first rain since the middle of July. The creeks which had been dry or practically so all summer started to flow and the first indication of trouble, was the day before Thanksgiving when a fishy odor was detected in the water. By November 30th, and on December 1, this fish odor had developed into a "decomposed whale odor" and if this was not enough there was froth and foam everywhere. Foam over 4 feet thick on the raw water basin, 2 feet thick on the walks leading to the basin, and below Dam No. 1 which is just a mile below the plant on the Ohio River, the foam was from 11" to 24" thick. The foam blanket extended 700 feet from shore to shore, and down stream from the dam from 200 feet on one side to more than a mile down stream, on the other side of the river.

No Chemical Engineer Needed to Identify the Trouble

It did not take a chemist or a detective to know what the trouble was, any four year old child that ever blew bubbles recognized the material. However, to verify it, we collected 70 wash tubs of the foam (we could have collected a million tubs), brought them into a warm room where the bubbles burst, and all in all, we collected four and one half gallons of material which upon chemical analysis turned out to be almost pure synthetic detergent. We also filled a special tank holding 12,500 gallons of water on December 1, when the detergent concentration was at its highest. At 2:00 PM on December 1, 1953, the laboratory test for the detergent content showed 12 ppm. The average for the day was over 4 ppm of detergent.

Purification Troubles

The intense fishy odor was eliminated by using activated Carbon (40 ppm), or chlorine dioxide at four times our normal dose—namely, 12 lbs. sodium chlorite per million gallons. However, there was very little reduction in taste. All kinds of difficulties with floculation occurred. The floc simply would not settle and large particles would float on the water, held up by the bubbles. The water going through the filters was a light straw color, and the iron content of the finished water rose to over 0.3 ppm, with black water (not red water) appearing all over town. The black water was due to black oxide iron, evidently caused by the high chlorine content changing the red oxide over to the black oxide. The detergent present seemed to hold the oxide in a peptized state.

The Ohio River water averages about 2 ppm of iron in the form of ferrous sulphate. Iron sulphate and detergents seem to have a special affinity for each other, with the result that the iron will not floc out at normal purification pH. To remove the iron salts completely it was necessary to raise the pH to the unprecedented figure of 10.3 by increasing the lime feed to over four times the rate that is required normally.

Degree of Detergent Removal

Some of you readers will want to know if the detergents were removed by the purification process and what effects detergents have on the human system. I can't answer either question. In dozens of tests the average reduction of detergent content of the water before and after going through the plant showed only about a 20% reduction.

What happened to us here in Wheeling will certainly happen to others elsewhere with the ever increasing use of synthetic detergents. Plants in communities where there is a sewage treatment charge based on the oxygen demand of the sewage or waste find that because there is no B.O.D. in synthetic detergents, whereas there is in soaps, that they save money by use of detergents. Personally I feel that this synthetic detergent problem is the biggest thing to face the water works operator since the earlier experience with phenols discharged to streams by industry.

Creativeness

Creative joy and creative pride go together. We can all be proud of something we have done or made—a sale, a sermon, a cathedral, a chicken coop, an improved method, or just a "gadget."

MAGNETIC OXYGEN ANALYZER of the indicating type. The range of oxygen removal covered is 0 to 33 per cent.

The Magnetic Oxygen Analyzer in Studies of Oxygen Uptake

A New Instrument for Measuring Aerobic Oxidation Rates

by **SAM R. HOOVER, LENORE JASEWICZ,** *and* **MANDOR PORGES,** ***U.S. Dept. of Agriculture, Eastern Regional Research Laboratory, Philadelphia, Pa.***

THIS report presents a simple procedure for measuring oxygen uptake from the gas phase that appears to have great utility in both research studies and the control of aerobic treatment processes.*

The instrument employed was the magnetic oxygen analyzer developed by Linus Pauling and associates[1] for the armed services during World War II, commercial models of which are manufactured by Arnold O. Beckman, Inc.**

The model C instrument with an operating range of 100-160 mm. was designed for physiological studies. This range covers oxygen removals of 0.33% at ordinary atmospheric pressures with an accuracy of ± 1% of scale range, or about ± 0.1% O_2. and is therefore well suited to the study of aerobic fermentation processes. It is an indicating analyzer; recording models are available but were not used in this study.

The principles and applications of oxygen recorders in industry were reviewed recently by Riggs[2], but the present application to measurement of oxygen removal in biochemical oxidation processes was not discussed.

How the Analyzer Operates

The basic principle involved is that oxygen is the only common paramagnetic gas; that is, it is attracted into a magnetic field. A tiny glass dumbbell filled with nitrogen or oxygen is suspended between two pairs of magnetic pole tips by a stretched quartz torsion fiber. The oxygen in the gas stream is attracted to the area between the poles, thus displacing the dumbbell. The dumbbell rotates in the magnetic field to an equilibrium position dependent on the magnetic rotational force and the torsional force of the quartz fiber. A mirror attached to the dumbbell indicates the equilibrium position by reflecting a light beam on a calibrated translucent scale. In the recording apparatus, an electrostatic compensation is used to maintain a null-point balance. The balancing electrostatic force is converted by a unique system into a potential that can be recorded on commercial recording potentiometers[3].

The gas sample is passed continually through the apparatus, which has a capacity of 9 cc, at any flow rate between 50 and 260 cc/min. Water vapor dilutes the oxygen, and

* This paper was presented at the conference on Instrumentation in Water, Sewage, and Industrial Waste Treatment at Manhattan College, New York City, and is published with permission.

** The mention of products does not imply endorsement or recommendation by the Department of Agriculture over other products of a similar nature not mentioned.

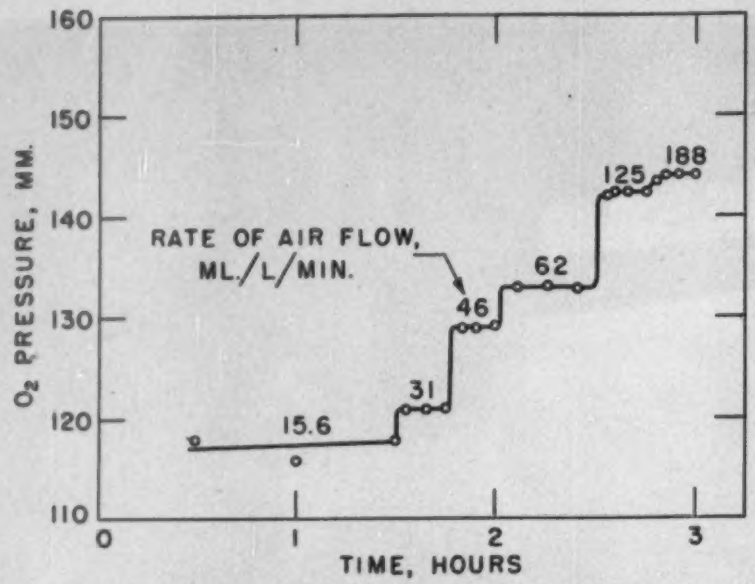


Fig. 1—CONSUMPTION of oxygen from air supplied to synthetic milk waste

therefore samples must be either wet or dry.

In the work reported here, the compressed air used was passed through water at the operating temperature of the aerator and sampled intermittently to determine the O_2 content of the air. An alternative procedure was to pass the air through the aerator at extremely high rates to get the control value. The gas sample was removed from the aerator by an inverted funnel with the rim just below the surface of the liquid. The outlet of the oxygen analyzer vented the gas at atmospheric pressure. A noteworthy feature of this system of analysis is that the oxygen transfer in the liquid is given directly by dividing the decrease in O_2 pressure by the observed pressure of the control.

Design of Experiment

A stable, balanced, aerobic flora was established which oxidized at a high rate a synthetic milk waste consisting of a 0.1% solution of skim milk in water. The aerator was a Humfeld type[3], with an inverted funnel at the liquid level to catch the sample of gas coming off the surface. The compressed air supplied to the system was passed through a dust trap and a calibrated flowmeter. The effluent gas sample was similarly measured and passed through the oxygen analyzer. The other conditions of the experiments were the same as those described previously[4]. Vigorous agitation and mixing of the solution with accurate control of temperature and aeration, essential features of this study, are readily obtainable in this equipment.

After several exploratory runs, the oxygen removed by the culture was measured as a function of the rate of air flow into the system. The purpose of the experiment was to test the utility of this type of measurement; no attempt was made to obtain optimum rates of biochemical oxidation.

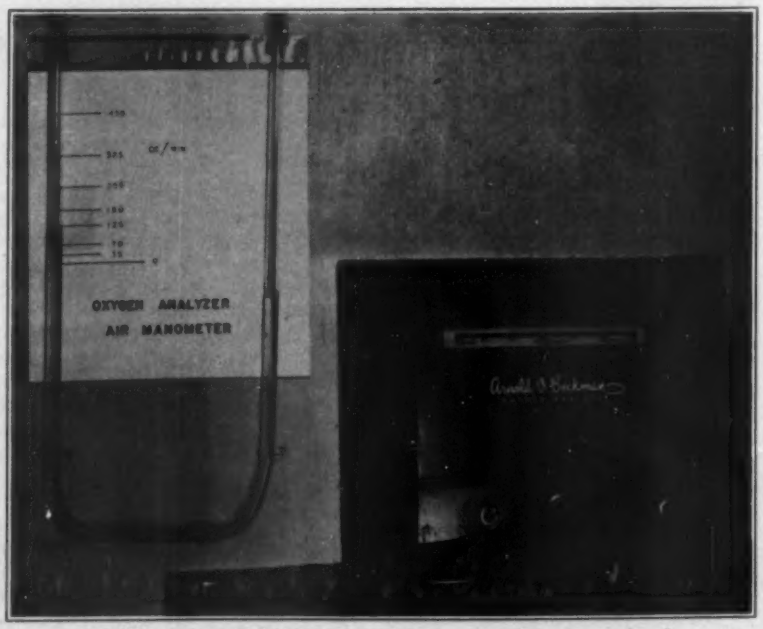
Procedure and Results

It was difficult to get steady readings of O_2 pressure in the effluent gas at extremely low air flow. After some adjustments of the rate, however, the system stabilized at about 118 mm O_2 pressure at 15.6 ml/L air flow (250 ml/16 L). The data of Fig. 1 were then obtained within a 2-hour period. The response of the instrument to a change in air supply was rapid; a new equilibrium position was reached in 2 to 3 minutes, the time required to flush the system. The data are given in tabular form (Table 1) to show the simplicity with which the O_2 transfer and the rate of O_2 utilization can be calculated.

The low rate of oxygen uptake at the lowest air flow is noteworthy. Although 21% of the oxygen was taken from the air stream, leaving 79% unused, yet it is apparent that the bacterial cells were receiving insufficient oxygen. The dispersion of air was not adequate to maintain aerobic conditions; the instability of readings already referred to undoubtedly reflect this unbalanced biological situation. Satisfactory steady-state conditions were maintained at the higher rates of aeration, as shown by the fact that the rate of uptake varied only between 1.6 and 1.9 for a 6-fold increase in rate of aeration.

Graphical Solution is Designed

The constant rate of oxidation on a volume or a weight basis, if adequate air is supplied, was predicted from previous studies, wherein the rate of oxidation was constant above about 0.5 ppm dissolved oxygen[5]. This fact makes possible an algebraic or graph-



CALIBRATED FLOWMETER and oxygen analyzer set up employed
The effluent gas sample flow was measured and oxygen consumption was determined

ical solution of the data, as illustrated in Fig. 2. Inasmuch as the O_2 consumption is independent of rate of aeration, the transfer efficiency times the amount of O_2 supplied is a constant.

This is the equation of a simple hyberbola $xy = k$, and plotting y, oxygen transfer, against 1/x, the reciprocal of the rate of aeration, produces a straight line with a slope k, which is proportional to the rate of O_2 uptake. The abscissa of Figure 2 is in terms of air flow: for calculation of O_2 uptake it must be converted to oxygen flow. The abscissa is therefore divided by 149.5/760 or 0.197 to obtain the slope of the line in terms of oxygen uptake. A resultant value of 1.23 ml O_2/L/min. is obtained, which multiplied by 32/22.4 equals 1.76 ppm O_2. This value can be compared with the mean of the last 5 values in column 4 of table I, which is 1.79. Thus the graphical and arithmetical solutions agree excellently. The marked deviation of the point of the lowest aeration rate is again evidence of a failure to supply adequate oxygen to the microorganisms.

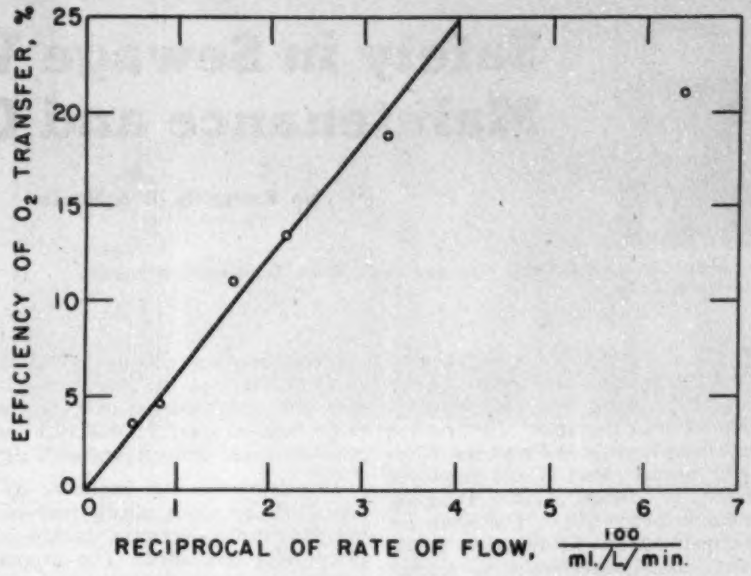


Fig. 2—Oxygen transfer efficiency vs. reciprocal of rate of flow

A constant rate of oxygen utilization is indicated by the linear relation from 0 to 3 units. The point at 6.4 units shows that the oxygen requirement is not satisfied

Oxidation Rate Breakpoint

Fig. 2 has an additional value for research purposes in that the "breakpoint" at which the air supply becomes insufficient is clearly shown. The direct plot of oxygen transfer vs rate of air flow (not shown) is more difficult to interpret, for the hyperbolic function is changing rapidly in the critical region, and the point where the air supply becomes insufficient is not apparent.

In biochemical research, the rate of oxidation per unit of cell tissue present is an extremely valuable parameter. This rate, called the oxidation quotient, QU_2, is readily calculated from the data obtained if a determination of cell dry weight is made. The determination was inadvertently not made in the experiment cited, but other determinations on similar studies indicate there were about 2500 ppm cell solids present. The increase in amount of cell tissue during the experiment was also neglected in this calculation, but an increase of more than 10% in weight in the 2-hour period during which the data were obtained would not be expected. The tabulated values are therefore satisfactory for comparison with related data and for illustration of the utility of such measurements.

Discussion

The experiment performed illustrates the valuable data obtainable on an aerobic oxidative system by use of O_2 analysis. The activity of the activated sludge floc and the performance of the air-dispensing system can both be determined almost instantly. Such information is essential in research studies. In routine control of plant operation, it would seem that this type of analysis would have great value, for it could easily be used as a constant record of plant performance, a record that would show directly whenever the system went out of balance. The instrumentation required to convert this measurement to a recording-controlling system would not be difficult; the air supplied to the activated sludge plant could be controlled to maintain an O_2 content of the effluent gas within a definite range. At times of low oxygen demand much less air would be pumped into the system with resultant economy in the power required.

The utility of such measurements is not restricted to sanitary engineering; they could be applied in fermentation plants using aerobic processes for the production of antibiotics, vitamins, and food and feed yeasts. The comments above can be applied directly in this whole field of aerobic biochemical processes.

In this short presentation, the emphasis has been placed on the utility of the magnetic oxygen analyzer in a biochemical study of sanitary engineering processes. Those who are interested in the broader phases of this work are referred to a recent review[6] of the research on aerobic treatment of dairy waste carried out in this laboratory.

Table I

OXYGEN CONSUMPTION BY 16 L OF AERATOR CULTURE AS A FUNCTION OF AIR SUPPLY

Air Flow		Oxygen Utilization		
ml/L/min. (Col. 1)	mm (Col. 2)	% (Col. 3)	ppm/min. (Col. 4)	ml/gm/hr (Col. 5)
15.6	31.5	21.1	0.92	15.6
31.3	28.0	18.7	1.65	27.7
46.9	20.5	13.7	1.81	30.8
62.5	16.5	11.0	1.94	32.6
125	7.0	4.7	1.65	27.9
188	5.25	3.5	1.86	31.5

Data in Column 3 were calculated by dividing (2) by the 0_2 content of influent air, 149.5 mm.
Data in Column 4 were calculated as follows: (4) $= \frac{(1) \times (2)}{760} \times \frac{32}{22.4} =$
(1) × (2) × 1.88 × 10^{-3} ppm 0_2/min.
The actual atmospheric pressure should be used for most accurate results.
Gas law corrections for temperature (30°C) were not made.
Data in Column 5 were calculated on basis of 2500 ppm solids present. This value is an approximation (see text).

References

1. Pauling, L., Wood, R. E., and Sturdivant, J. H., J. Am. Chem. Soc. 68 (1946), 795.
2. Riggs, O. W., Instruments, 26, (1953), 248.
3. Humfeld, H., J. Bact. 54 689 (1947).
4. Hoover, S. R., and Porges, N., Proc. 5th Ind. Waste Conf., Purdue Univ. Eng. Ext. Dept. Ser. 72 (July 1950), p. 137.
5. Hoover, S. R. and Porges, N., Sewage and Ind. Wastes 24, (1952), p. 306.
6. Porges, N., Jasewicz, L., and Hoover, S. R., Applied Microbiology, in press.

Safety in Sewage Works Maintenance and Operation

The Seventh of a Series

by **LEROY W. VAN KLEECK**, *Prin. San. Engr., Conn. State Dept. of Health, Hartford, Conn.*

THIS is the concluding installment of the series which started in our July 1953 issue and has appeared monthly since that time. The first five installments covered Employee Safety in Sewers (Part I) and Employee Safety in Sewage Booster Pumping Stations (Part II). The sixth installment is devoted to safety measures relating specifically to sewage treatment plants.

Many of the recommendations made in earlier installments apply with equal force to the present discussion and are of value to review.

Part III
Employee Safety in Sewage Treatment Plants

Section C

Prevention of the Dangers from Noxious Gases or Vapors and Oxygen Deficiency

Sludge Digestion Tanks

The gas produced by the digestion of organic solids in sludge digestion tanks is colorless and flammable and may be practically odorless. It contains principally methane and carbon dioxide with small amounts of hydrogen, nitrogen, hydrogen sulphide and oxygen. Traces of carbon monoxide or phosphine may be present. The combustible gases constitute about 65 to 75 per cent of the total gas volume, and sludge gas has an explosive range between about 5.3 and 19.3 per cent by volume when mixed with air.

The flammable and explosive nature of sludge gas is usually realized, but its constant potential hazard is often under-estimated. The proper control of sludge digesters and the collection and utilization of the gas produced require the attention of intelligent and well-informed operators to avoid burns or explosions. (Figs. 1 and 2).

Fire Hazard: Filled digesters* in active gas production present no explosion hazard. The sludge gas being produced under such conditions is under positive pressure, and thus sufficient air (oxygen) is not present to produce an explosion. Fires, however, may occur at any point of gas leakage: such as from a leaking petcock, a pressure-vacuum relief assembly on the digester roof, the peripheral clearance around a floating cover, or from any gas appurtenance. It is obviously good practice therefore to avoid open lights and sparks in the vicinity of such tanks. (Figs. 3, 4 and 5).

Explosion Hazard: Digestion tank explosions are associated with partially emptied tanks containing digested or digesting sludge. A gas explosion requires the presence of four conditions:

1. A flammable gas (sludge gas in this case).
2. Air (oxygen).
3. A proper mixture of (1) and (2). (In this case, 5.3 to 19.3 per cent by volume of gas with air).
4. A source of ignition.

Conditions (1), (2) and (3) are likely to exist: when digesters are being emptied for repairs or inspection, when digesters are being refilled with seed* sludge to re-start active digestion, or when digesters are inadvertently drawn down so low that air is sucked into the tanks through manhole covers or vacuum-relief devices.

When bottom digested sludge is withdrawn from fixed roof digesters the drawing in of air should be avoided by:

1. Pumping raw sludge into the tank at the same rate as the withdrawal rate of digested sludge.
2. Use of an automatic make-up water supply (float-operated).
3. Balancing of the digester atmosphere with sludge gas from a gas storage tank. This operation should

*Fixed-cover digesters filled to the overflow point, floating-cover digesters with covers floating on the supernatant liquor, and gasholder type digesters under gas pressure.

*Previously digested sludge.

Fig. 1—MODERN sludge digesters, West Haven, Conn.

Fig. 2—RESIDENCES are now close to sewage treatment plants.

Photo on right is view from top of a digestion tank. Safe operation of sludge digesters is important to protect near-by property.

be automatic in order to fill the void created with sludge gas.

In the emptying or filling of digesters, great care must be taken to avoid sources of ignition for the sludge gas until the digester is either completely cleaned or completely filled. Before entering emptied or nearly emptied digesters, tests should be made for explosive gas, hydrogen sulphide and oxygen deficiency, Forced ventilation should be used and safety belts should be worn by the workmen until the tank is completely cleaned.

The important factor resulting in explosions in partially emptied digesters has been a source of ignition. What are these ignition sources? The following are common ones:

1. Use of ordinary extension lamps. A cracked electric light bulb, sparking shut-off switch or defective cord serves as an ignition source.
2. Sparks from shoe nails or tools. (Non - sparking beryllium - copper alloy tools are available for use in and around structures where flammable gas exists).
3. Smoking or striking of matches.
4. Use of ordinary flashlights or lamps. A cracked bulb or defective switch serves as an ignition source.
5. Dismantling of sludge gas piping within digesters. Rapid oxidation of iron sulphide deposits within such piping when exposed to the air may create heat or flame.

When digesters are first placed in operation or returned to service after cleaning, an explosion hazard may be readily avoided by the simple expedient of first filling the digester with water or sewage. Seed sludge may be added, if available, and then the tank contents may be heated before adding fresh raw solids.

A word of caution is in order with respect to digested sludge withdrawal pipes from digesters. Such pipes or any pipes containing standing digested sludge *always* should be valved open at one terminus to prevent the building up of excessive gas pressures. Closed lines may develop gas pressures so high that joint failure of the piping and sludge leakage may occur. Sludge leakage within a digestion tank gallery might result in a very serious hazard.

Figs. 3 and 4—WARNING signs at approach to a digester and at entrance to a digester building.

Sludge Gas Collection and Utilization Systems

In the design of sludge gas collection and utilization systems, consulting engineers' practices appear to come under two schools of thought. One school favors the segregation of the gas piping and appurtenances in a separate explosion-proof structure (Fig. 6) containing no sources of ignition. The gas boilers or gas engines in such cases are placed in separate structures or rooms with outside entrance only.

The second school of thought considers the sludge gas piping and appurtenances of no greater hazard than that existing in other industrial applications or in homes and the gas system extends throughout the sewage treatment plant structures. (Fig. 7). In the interest of greater safety, the writer favors the first school, although by following this practice the first cost frequently is higher.

When the gas piping and appurtenances are dispersed throughout a sewage treatment plant, adequate and positive ventilation should be maintained to prevent gas-air mixtures from accumulating in the event of a gas leak. The piping should be tight and only approved gas safety appurtenances used. *Frequent checks for gas leakage should be made with a combustible gas indicator.*

During periodic check-ups of sludge gas collecting systems in Connecticut's sewage treatment plants, the writer invariably finds one or more leaks at most plants; where, if neglected, these leaks might have resulted in a serious hazard. Combustible gas alarms are available for particularly hazardous locations. (Figs. 8 and 9).

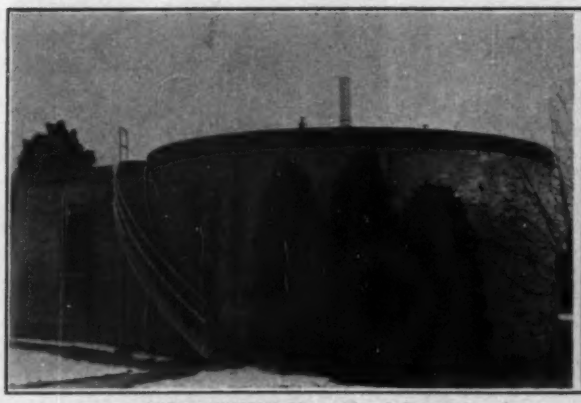


Fig. 5—SPIRAL STAIRWAY on side of digestion tank. The stairway affords easy inspection of gas controls on roof.

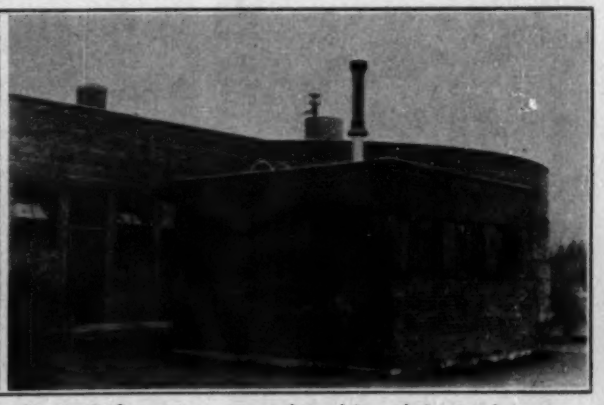


Fig. 6—GAS appurtenances are housed in explosion-proof structure. Concentration of sludge gas control equipment in separate building is safety measure.

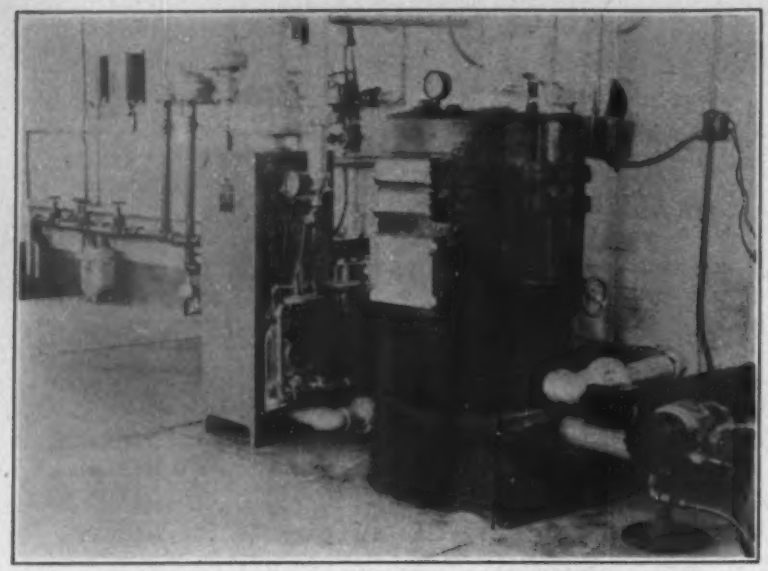


Fig. 7—BOILER ROOM of a sewage plant may contain all sludge gas appurtenances. Adequate ventilation at all times and periodical checks for gas leaks are necessary to prevent explosions.

Maintaining Positive Gas Pressure: Regardless of the location of gas piping or appurtenances the gas should be kept under positive pressure. *Positive gas pressures insure that the gas will not become mixed with air in the pipes or appurtenances.*

Manometers (Fig. 10) provide checks on gas pressures. They should be vented to the outside atmosphere to avoid gas escape or be used in explosion-proof structures. (Fig. 11). Light oil (S.A.E. No. 10 is satisfactory) should be used as an indicating liquid to prevent evaporation of the fluid column. Manometer releases should not be taped in an open position—a surge of gas may blow out the liquid in such cases and permit a continuous flow of gas into the structure.

Only approved types of manometers should be used and these should be frequently checked for gas leakage. *The use of unvalved open-end U-tubes as manometers in enclosed structures is a hazard of the first magnitude and their use should be strictly prohibited.* A surge of gas may completely empty the tube allowing large volumes of gas to fill the structure before the leak is detected.

Maintenance and Operation of Approved Gas Appurtenances

The Pacific Flush Tank Co. and Vapor Recovery Systems Co. are the two leading manufacturers of approved gas appurtenances and devices. Both companies have published excellent descriptive catalogs of their devices including design sketches, installation instructions and maintenance hints. Operators should avail themselves of this helpful information. The attention of operators is directed also to a helpful article on gas utilization facilities by Langford.*

Condensate Traps: These traps are used at the low points of the gas collecting system for the removal of moisture from the gas. (Fig. 12). The greatest moisture accumulation usually occurs at locations of temperature change.

Float-operated drip traps should *never* be used inside structures unless the condensate is *tightly* piped to the outside. The floats in such traps sometimes stick open, especially with age, permitting gas leakage into the room.

Open and U-tubes should *never* be used as condensate traps for the reason given under "Manometers."

The condensate in sludge gas needs to be drawn daily from some traps; other traps require infrequent attention. The amount of condensate often varies with the seasons.

The trap connections and condensate withdrawal valves must be kept tight to avoid gas leakage. The trap made by one manufacturer has an adjustable nut and valve spring for maintaining the proper pressure on the rotary valve. Valve leakage from the gas inlet port may be determined by means of a combustible gas indi-

*"Safety Considerations in the Design of Gas Utilization Facilities", Leonard L. Langford, Sewage Works Journal, Jan. 1945, page 66.

Fig. 8—AUTOMATIC gas alarm device. Wall mounted type.

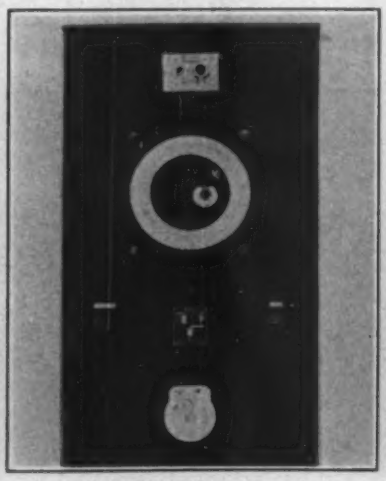


Fig. 9—AUTOMATIC gas alarm device. Top of panel mounted unit.

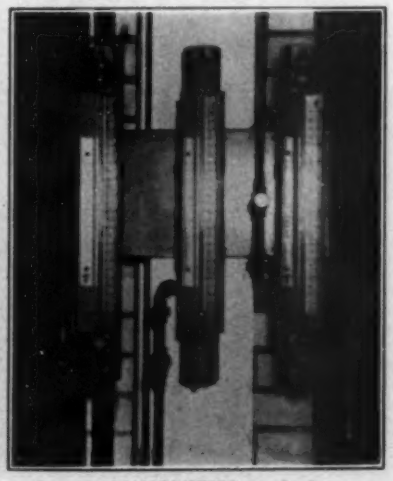


Fig. 10—MANOMETERS to check gas pressure. Wall mounted type.

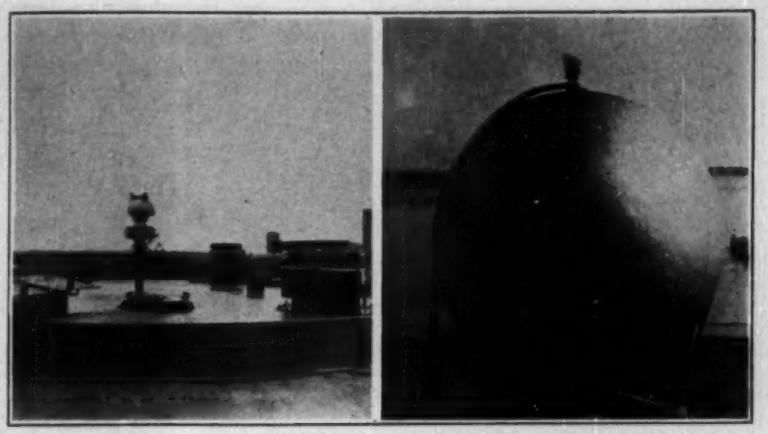
cator after venting the interior of the trap body with an air pump.

Pressure Regulators: Pressure regulators, which control the flow of gas to points of utilization or to waste gas burners, are provided with diaphragms. These regulators always should be vented at the top to the out-of-doors. This precaution is to avoid gas leakage inside structures in the event of a diaphragm failure. This is good practice even in a segregated explosion-proof structure. For a like reason the covers of pressure regulators should always be bolted in place and the diaphragms not exposed to atmosphere.

Neatsfoot oil applied sparingly to diaphragms will prolong their life. All moving parts, particularly the valve stem, should be lubricated occasionally with light machine oil. The omission of such simple maintenance is a frequent cause of failure. All too frequently operators give excellent maintenance to all sewage plant equipment except gas appurtenances which, after all, cannot be expected to function indefinitely without attention.

Flame Traps: These traps may be separate units or may be combined with pressure-relief units. The thermal plug side of flame traps always should be installed *toward* the source of flame. The flame arrester elements should be cleaned periodically or whenever manometer readings show excessive gas pressure losses through the device. Light lubrication of moving parts is suggested. The manufacturers give instructions in the before-mentioned catalogs on the replacing of the thermal plugs.

Pressure-Vacuum Relief Assemblies: These are installed on the top of digesters as an emergency relief for excessive pressures as well as a relief for possible vacuums which might cause structural damage. (Fig. 13). Mineral deposits accumulate on the face of the pressure relief valve and should be removed several times a year. Gas loss frequently occurs from lack of attention to this detail.



VACUUM-PRESSURE relief devices: Fig. 13—Mounted on sludge digestion tank roof. Fig. 14—Mounted on sludge gas storage tank.

The gas wastage occurring also may form hoar frost in winter from the moisture in the gas. Such hoar frost, if allowed to build up, might nullify the safety feature of the device. Any sustained leakage of gas at this point after cleaning of the device is indicative of incorrect adjustment of the main gas pressure regulator located elsewhere.

Gas Compressors: Serious gas leaks have occurred from the use of water-sealed gas compressors inside structures. Gas leakage may occur through the discharge check valves after the compressor shuts off, or from waste water discharge inside the structure. Such waste water contains much entrapped gas. Totally enclosed dry-type compressors are recommended.

Gas Storage Tanks: Gas storage units are safe when filled with sludge gas under pressure and when equipped with vacuum-pressure relief devices. (Fig. 14). When such tanks are removed from service for inspection and painting, the precautions given in the Federation's Manual of Practice No. 1 should be followed.

Gas Boiler Operation: It is preferable to locate gas boilers in a separate room with outside entrance only. When located inside the main sewage treatment plant building, a location at ground level is preferable to a basement location. In all cases, it must be remembered that an adequate air supply is essential for complete combustion of the gas. The boiler exhaust gases require a chimney of adequate area and height to avoid back draft. Many modern gas boilers have a built-in exhaust fan for preventing back drafts. Such fans may be installed in any boiler if draft conditions are poor. Boiler flues should be cleaned as necessary to prevent back draft.

Boiler safety devices should include a water level gage, water or steam pressure relief device, aquastat control of water temperature and a positive safety cut-off for the main gas supply in the event of a pilot light or ignition failure. These devices, especially the ignition cut-off, should be checked periodically to be sure that they are functioning.

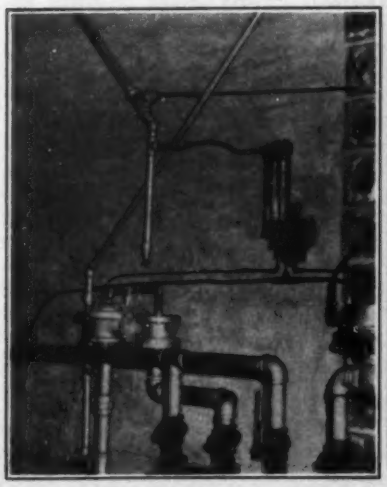


Fig. 11—VENTED manometers and pressure relief.
Flexible piping connects to outside vent pipe.

Fig. 12—SEDIMENT trap for sludge gas.
Has approved manual type condensate trap.

Chlorine Handling

Chlorine is an irritating gas which, when breathed, may cause injury to

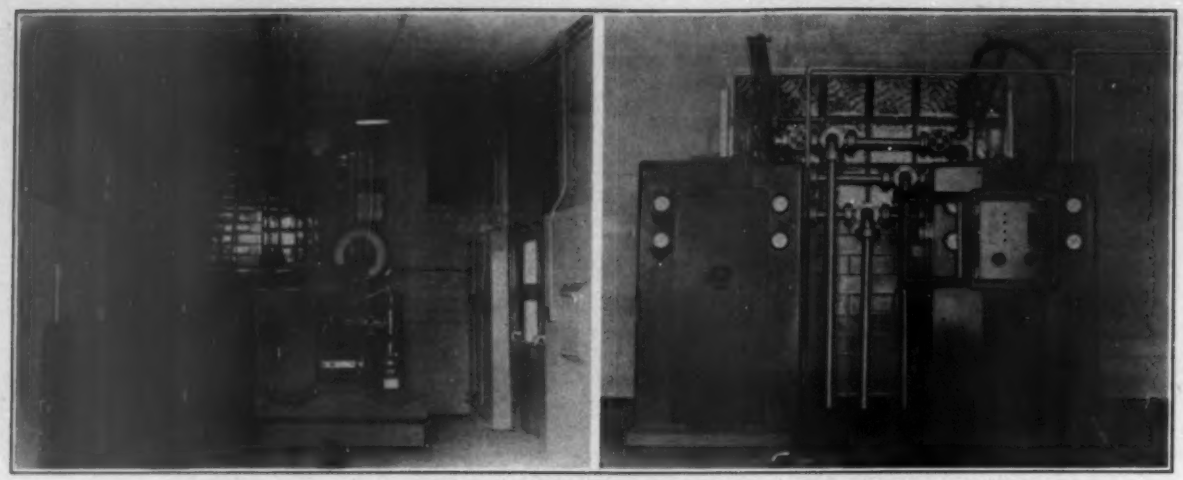


Fig. 15 and 16—MODERN chlorine container and chlorinator installations designed to facilitate safe handling.
Left—Ton container storage and scale room has two outside entrances, window into chlorinator room, and box in right wall for cannister gas mask available from inside or outside through double doors. Right—Chlorinator room, with entrance from outside only, and with window into treatment plant.

the air passages or lungs, inducing inflammation of the surfaces of the respiratory tract. It is a gas, greenish yellow in color, with a choking odor detectable in vary low concentrations. Chlorine will not burn. Gaseous chlorine is considerably (2.5 times) heavier than air and therefore hangs low in a structure.

Chlorine gas storage facilities should be located in a covered and heated structure with entrance from the outside only. (Figs. 15 and 16). Adequate ventilation is essential, preferably by both natural and mechanical exhaust provisions. Mechanical exhaust ducts should be located near the floor level.

The structure should be fire-proof and a fire sprinkler system installed for large installations using ton-containers.

Chlorine canister gas masks are suitable as respiratory protection for leaks resulting in a maximum concentration of no more than 2 per cent by volume of chlorine with air. For a serious leak a hose mask or compressed-air demand-type mask should be used. The reader will find detailed instructions on handling chlorine leaks and first-aid treatment for those exposed to chlorine poisoning in the Federation's Manual of Practice No. 1 and in a pamphlet entitled "Chlorine Manual" available free from the Chlorine Institute, Inc., 50 East 41st Street, New York 17, N.Y. Every user of chlorine should have the latter pamphlet available for reference.

Section D

Prevention of the Dangers from Radioactive Hazards

Following an atomic explosion of the ground or underwater type, a radiation hazard could exist within a sewage treatment plant from radioactivity present in the sewage or in the flushing water discharged to sewers from the decontamination of structures and streets within the bombed area. Sewage plant equipment in contact with sewage or sludge should in such cases be monitored with a portable Geiger meter equipped with a beta-gamma probe.

It is not likely that the radioactivity will persist for more than a few days, but the possibility of radioactivity in the sludge should not be dismissed. Sludge to be used as a soil conditioner under such circumstances should be monitored. In cases of severe contamination of a sewage plant from atomic bomb bursts or decontamination operations within the bombed area, abandonment of the plant might be necessary for a time. Details on radioactivity hazards in sewage works operation will be found in a paper by the author to which reference was made in Part I.

Conclusion

The hazards in the sewage works field are many and varied. Physical injuries and body infections are a continuous threat and do occur with regularity. Explosions and asphyxiation from gases or oxygen deficiency are of less frequency; there is more carelessness about these hazards until concern is stimulated by a spectacular incident. The pleas of safety engineers too often are ignored until the facts strike home. Then it is too late.

It is the responsibility of sewage works supervisors to acquaint themselves with the occupational hazards associated with sewage works maintenance and operation, and then to take steps to avoid them. Remember, accidents do not happen—*they are caused!* Efforts should be made to correct design hazards; gas and oxygen deficiency equipment and other safety apparatus should be purchased *and used;* and personal safety rules should be enforced. The operation of sewage works is a dangerous occupation. Never forget it.

The ABC of Safety:

*A*lways *B*e *C*areful!

Credit for Illustrations

Photographs used for illustrations are by the author except Figs. 8 and 9 which were supplied by courtesy of the Mine Safety Appliances Co., Pittsburgh, Pa.

Maurice V. Hegarty Dies Suddenly

Maurice V. Hegarty, Vice-Pres. and Chief of Operations, Jamaica Water Supply Co., Jamaica, N.Y., died on December 24, 1953. He had been an employee of the company since 1932.

Mr. Hegarty received his B.S. degree in electrical engineering from Notre Dame University. He was a member of the Am. Water Works Assn.

The man who *doesn't* read has no advantage over the man who *can't.*

Report of the S & IW Federation's 26th Annual Meeting in Miami

III—Concluding Installment Reviewing Technical Sessions

THIS is the third and concluding installment of our report on the meeting of the Federation of Sewage and Industrial Wastes Associations in Miami, October 13-16, 1953. The first installment appeared in the December, 1953 issue and the second in the January issue.

The papers reviewed here covered a wide variety of subjects discussed in the association's technical sessions.

Technical Sessions

Basic Considerations in Sewerage Planning

"SEWERAGE PLANNING FOR METROPOLITAN FRINGE AREAS" was the title of a paper presented by M. H. Klegerman, Consulting Engineer, Alexander Potter Assoc., New York, N. Y. He clearly summarized general, engineering, and financing considerations which apply to this type of service.

There are about 170 metropolitan areas in the U. S. surrounded by communities in the "fringe" classification (more or less developed sections bordering on the outer rim of the metropolitan center with which they have common social and economic interests). For example, Richmond, Va., has an area within city limits of 24,000 acres—but its metropolitan area comprises nearly 47,000 acres; and an area of 280,000 acres was considered in planning intercepting sewers and treatment facilities for the future sewerage needs of the city. As new decentralized cities become a reality, fringe areas are likely to increase in number and in size.

Fringe areas may be expected to have populations of 125 to 150 or more persons per sq. mi. when demands for public sewers begin. Arlington County, Virginia, grew so rapidly in population that it illustrates transition from "fringe" to "suburban" to "urban" to "metropolitan" in giant steps. This county's population in 1935 was 35,000—with less than 10 per cent served by sewers. Now the population is 155,000—with 360 miles of sewers, and a 20 mgd treatment plant, serving about 93 per cent of its population. (See Mr. Klegerman's chart.)

Fringe areas are unlikely to be "a public body politic and corporate." Therefore, in order to provide legal, financial and administrative means for a comprehensive sewerage plan, it is necessary to create political entities endowed with power to incur debt, collect charges for service, and with rights of eminent domain and similar basic authority. This may necessitate the creation of Improvement or Sanitary Districts, or Sewerage Authorities, or require annexation by the adjoining municipality.

Fringe Area Sewerage

M. H. Klegerman
Cons. Engr.
Alex. Potter Assoc.
New York, N.Y.

Charles R. Velzy
Nussbaumer, Clarke,
& Velzy
New York, N.Y.

In many instances the use of existing facilities, or planning for joint use of proposed facilities with an urban or metropolitan neighbor, warrants investigation. Fairfax County planned with the City of Alexandria for the combined use of a proposed trunk sewer and treatment facilities to serve a portion of the county area. The joint use and lease arrangement saved on initial construction cost $2.4 million on a $10 million project, together with estimated savings in operating costs totalling nearly $1.5 million for the first 19 years.

In large areas, there are substantial engineering, economic, and political considerations which determine the possibility of extending the facilities of a metropolitan center. An engineering investigation decided unfavorably on the wisdom of providing sewage disposal facilities for Arlington, Fairfax, Alexandria, and Falls Church at the District of Columbia treatment works. Under different circumstances, fringe areas (portions of Prince Georges and Montgomery Counties in Maryland) can advantageously be treated at the District plant; so much so, that these fringe areas of Washington plan to discontinue operating relatively new treatment facilities of their own and use the District plant.

Mr. Klegerman also discussed the difficulty of making estimates of population growth and its distribution. He noted that design procedures in fringe area sewerage practice are similar to those elsewhere—but a planning aid would be provided by the development of more data on peak and average flow ratios. Financial planning should provide for setting aside funds from revenues for future extensions of the system.

CHARLES R. VELZY, Partner, Nussbaumer, Clarke and Velzy, Consulting Engineers, New York, N. Y., discussed this paper. He emphasized the variable conditions which make it impossible to use a single formula for planning.

Sanitary Districts, for example, have proven desirable in the case of Chicago, Minneapolis-St. Paul, Hampton Roads, etc., where local conditions are entirely different from those at Washington. He described the situation at Elmira, N. Y., where a 15-year-old plant is overloaded, and a new treatment plant has just been put in operation. Industries already are in existence and large areas have potentials for future residential development. The industries, in this instance, might contribute a far greater future "fringe area" load.

New Jointing Materials for Sewer Pipes

"RECENT DEVELOPMENTS IN JOINTING MATERIALS FOR SEWER PIPES" were described in a paper presented by Donald F. Deakin, Water and Sewer Division, The Atlas Mineral Products Co., Mertztown, Pa.

Sewer lines, he pointed out, are predominately constructed of vitrified clay. The efficiency of the best available jointing materials depends largely on the installation methods employed—and factors which influence the selection of particular materials are geographical considerations, root problems, etc. A "perfect" pipe joint has not yet been devised.

The hot-poured compounds (filled asphalt joints) were developed 50 years ago. These compounds make strong, economical joints and are easy to apply. Mr. Deakin reviewed the characteristics of filled plasticized sulfur compound as jointing materials, filled coal tar pitch, hot poured filled plastic, precast asphaltic, cement and

Ralph E. Fuhrman
Superintendent
Sewage Treatment Plant
Washington, D.C.

Programmers

Philip F. Morgan
Prof., San. Eng.
Univ. of Iowa
Iowa City, Iowa

Donald F. Deakin
Sales Engr.
Atlas Mineral Prod.
Mertztown, Pa.

mortar, chemically resistant materials, tubular joints, vinyl plastisol joints, rubber coupling joints, and straight-end pipes. Mr. Deakin suggested that conditions of use determined the selection of the proper jointing compounds. Hot poured filled asphalt is generally satisfactory where root resistance is not of importance. Where root resistance is essential and where good adhesion is imperative, the hot poured filled plastic type of joint should be used. Either type of joint is satisfactory for handling *cold* industrial wastes; but where the wastes are hot or contain solvents, then a combination joint of infusible furane and plasticized sulfur cement will be most successful.

MORRIS N. LIPP, Asst. City Manager and City Engineer, Miami Beach, Fla., in discussing this paper, noted additional factors which determine the selection of jointing materials. There are isolated special conditions such as stable manholes and unstable pipe where a flexible joint is necessary.

The factor of deterioration is important where certain ground waters may attack metallic materials, or where dissolved gases may attack cement. Construction operations, he agreed, are highly significant: the total cost of a job may be materially affected by subsequent failure of pipe joints.

General discussion from the floor brought out the fact that manufacturer's recommendations on the selection and use of products provide the only available instructions. There are available a variety of satisfactory methods and materials for jointing tongue-and-groove concrete pipe.

How to Maintain Sewers

"SEWER MAINTENANCE PRACTICE IN LOS ANGELES" was described by W. A. Schneider, Director, Bureau of Sanitation, Dept. of Public Works, Los Angeles, Calif.

The Sewer Maintenance Division, one of four divisions in the public works department, is responsible for operation of all sanitary sewers, storm drains, structures, and plants (except the sewage treatment plant). As the city has a population of over 2 million within a 450 sq. mi. area, some 3,790 miles of sanitary sewers are needed. (A recent bond issue of $31 million will enable the construction of new trunk, interceptor, and relief sewers.) There are 780 miles of storm drains and 30,500 manholes in the city.

An administrative section and four operating units comprise the sewer maintenance division: Administrative, pipeline maintenance, channel maintenance, operation and repair, and industrial waste control. The organization is flexible, having regularly assigned specialized groups. A part

Toxicity
Edward J. Cleary
Dir. and Chief Engr.
ORSANCO
Cincinnati, Ohio

Maintenance
Kerwin L. Mick
Supt. and Chief Engr.
Sanitary Dist.
Minneapolis, Minn.

of its policy is to promote inservice training and to encourage employees toward broader skills; employee morale is at a high level. Emphasis is placed on preventive maintenance. All 27 pumping stations and five storm water pumping stations are automatic in operation. Sewage odors are a critical problem along outfall sewer routes.

Explosive gas surveys are made regularly to determine system safety. A truck and two men do the entire job, using a combustible gas indicator activated by vacuum from the truck engine. The sewer atmosphere sample to be tested is "sniffed" from a manhole through a long copper tube—the field test being made from within the cab of the truck. By this means, the crew is able to test 300 to 500 manholes per day. If combustible gas is found, seepage of fuel gas usually is responsible; the gas utility is notified and makes further investigations and reports.

There are 42 field crews in pipeline maintenance work. For normal cleaning of sewers 24-in. or less in diameter, increasing reliance is placed on sewer balls and cones. For cleaning larger sewers, and for removing roots, hand rodding, power cleaning machines, and power buckets are used. All sewers are inspected at least twice yearly. There is a constant search for better and faster tools to do jobs. While good sewer practices are of primary importance, the public and city officials are slow to understand this phase of operation.

M. B. NIXON, Engr. of Sewers, Sewerage Dept., Atlanta, Ga., in his discussion, agreed on the need for greater emphasis on sewer maintenance programs. He pointed out that the routine flushing and cleaning of sewers improves the condition of the raw material received at the treatment plant. Meetings and short schools, he believes, should give more time to considering the improvement of maintenance programs.

Digester Scum Control

"SCUM CONTROL IN SLUDGE DIGESTION" by Ralph E. Fuhrman, Deputy Director of Sanitary Engineering Dist. of Columbia, Washington, D.C.

Mr. Fuhrman formerly superintendent of the Washington, D.C., sewage treatment plant, told of the severe digester scum problem at the Washington plant and the various schemes tried to control the build up of the scum cap in 84 ft. diameter fixed roof digesters to depths of 8 to 10 feet. Various methods aimed at agitation and liquifaction of the scum cap (15% or better solids) eventually led to a scheme of gas recirculation involving gas compression and discharge in a manner of getting beneath the scum. The recirculated digester gas is discharged through only four down tubes equally spaced over the area of the 84 ft. diameter digester. The method, which has been patented, has been designated the "PEARTH PROCESS"—the name "Pearth" being the initials of the last names of the six members of the D.C. Plant operating staff participating in the development of the process. The process is being marketed under this name by the Pacific Flush Tank Co.

The recirculated gas rising around the down tubes creates a hole through the 8 to 10 ft. scum about 5 ft. in

diameter within a few minutes. From this point chunks of scum break off and become disintegrated in the agitated pool until the entire scum mass becomes liquified. Within a 13 day period of gas recirculation at the rate of 140 cfm through the 84 ft. diameter digester the scum blanket diminished from 9.5 ft. thickness to 4 ft. thickness (12.4% solids). Reducing the rate of gas recirculation to 40 cfm for the next 14 days resulted in further scum liquifaction to 6.7% solids content of which 62.6% was volatile.

Gas production increased from 9.5 cu. ft. per pound of volatiles entering the digester to 14.0 cu. ft. per pound. Gas analysis remained the same, regardless of the increased production. Evidence is available to indicate that with gas recirculation to liquify the scum heated digester loadings can be increased to at least 0.12 to 0.15 pounds of volatile solids per cu. ft. per day. The process is being installed at the Tulsa, Okla. plant with floating cover digesters and at Toronto, Ont. with fixed cover digesters.

L. E. LANGDON, of Pacific Flush Tank Co., further described the process, stating that the 40 c.f.m. gas recirculation rate under 5 lbs. pressure would be ample for the 84 ft. digesters. The gas would be admitted 10 ft. beneath the surface. At Tulsa the scum problem is especially severe because of meat packing wastes. At Toronto an 80 cfm compressor is going in.

R. S. Rankin
Engineer
The Dorr Co.
Stamford, Conn.

Programmers

Wilbur N. Torpey
Senior Civil Engr.
Public Works Dept.
New York, N.Y.

Hayse H. Black
Chief, Indus. Wastes
U.S.P.H.S.
Cincinnati, Ohio

Accelerated Sludge Digestion

"STUDIES OF ACCELERATED DIGESTION OF SEWAGE SLUDGE" were reported on by Philip F. Morgan, Prof. of Sanitary Eng., Univ. of Iowa, Iowa City, Iowa.

Prof. Morgan reporting on a 10 month pilot plant study of accelerated digestion in which bottom gas diffusors were employed for digester agitation stated that digester capacity providing for 0.2 ibs./vol. solids/cu.ft./day proved ample with agitation. In the study the loading was 0.262 lbs./vol. solids cu.ft./day to a digester of 0.39 cu.ft./capita capacity.

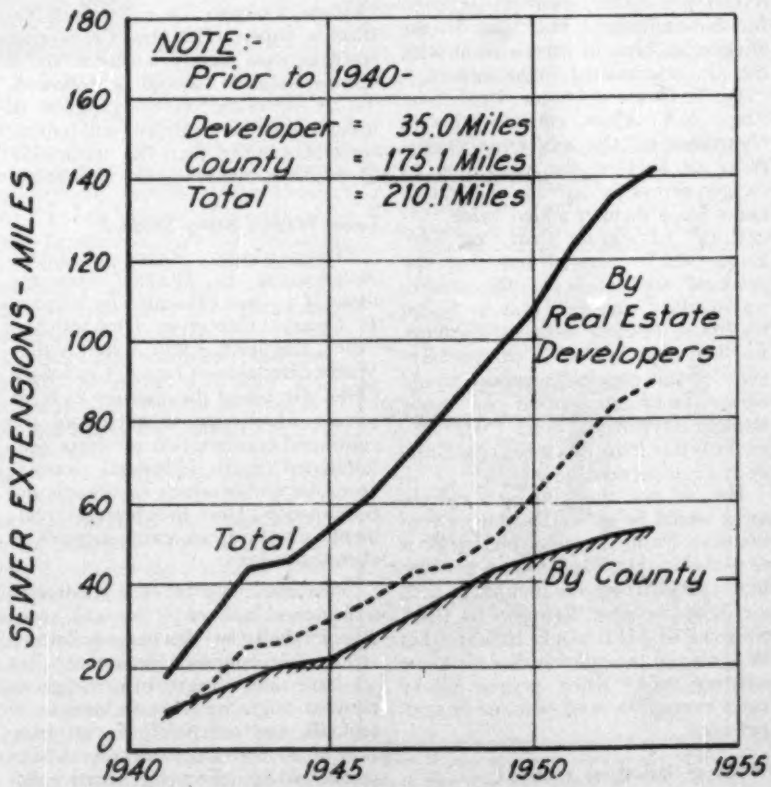
For secondary digestion it was Prof. Morgan's opinion that sludge lagoons had been too little used as a practical and economical procedure.

J. H. BLODGETT, Supt. Sewage Treatment, Columbus, Ohio, reported on a full plant scale study of the scheme developed by Prof. Morgan. A digester of 106,000 cu.ft. capacity with fixed-roof was employed. Morgan's claims were confirmed in the 128 day study. Solids loading was gradually increased to and then maintained at 8.5 lbs./cu.ft./month. Gas recirculation was at the rate of 76 cu.ft./min; temperature 84 to 90° F; detention 26 days; gas production 7.0 cu.ft./lb. volatile solids. The single undesirable feature was the higher moisture content of the digested sludge, which however was o.k. for the vacuum filters.

High Rate Sludge Digestion

"HIGH RATE DIGESTION OF ACTIVATED AND PRIMARY SLUDGE" by Wilbur N. Torpey, Sr. Civil Engr., Dept. of Public Works, N.Y. City.

Mr. Torpey reported on studies of digester operation since Dec. 1951 at New York's Bowery Bay plant, when a mixture of high-rate activated sludge and primary sludge is digested. In this study the sludge before entering the digester was thickened to 11% solids. Sludge recirculation was provided. Sludge thickened was 80% volatile and had a pH of 5.5. The digested sludge (31 day displacement time) contained 5.5% solids of which 55% was volatile. Liquor, alkalinity was 6200 ppm. Findings were that one digester with pre-thickening of sludge input gave operating results equal to 4 digesters operated in orthodox manner. Need for secondary digestion was shown not to exist. Digester capacity of 0.5 cu.ft./capita proved ample.



PRIVATE vs. PUBLIC construction of sewer extensions, Arlington County, Va., as described by Mr. Klegerman.

John F. Laboon
Cons. Engr.
Allegheny San. Auth.
Pittsburgh, Pa.

Discussors

Rolf Eliassen
Prof., San. Eng.
M.I.T.
Cambridge, Mass.

Daniel A. Okun
Asst. Engr.
Malcolm Pirnie Engs.
New York, N.Y.

In more recent studies on a pilot scale with sludge thickened to only 6% solids (pH 5.7) had produced digester sludge of 3.4% solids (58% vol.) with pH of 7.1. Gas produced contained only 2% more carbon dioxide (36% total) than normal gas.

Mr. Torpey's conclusions were that with program operation heated digesters (90-95F), providing only 0.25 cu. ft. capacity per capita, will do the same job as those providing 4 to 5 cu.ft./capita.

R. S. RANKIN, Manager Sanitation Sales, The Dorr Co., Stamford, Conn., speaking as a scheduled discussor, stated that the N.Y. City study had indicated that continuous digester feed with pre-thickened sludge would permit provision of only 0.5 cu.ft./capita digester capacity, providing 31 days displacement, as equal to 2.1 cu.ft. capacity and 54 days displacement. Thickening tanks would be far less expensive than providing four times the digester capacity. Savings in plant design should amount to $3.00 per capita. Continuous feed would produce continuous supernatant liquor displacement which might be another advantage when the liquor is returned to the head of the plant.

MR. BARGMAN, of the Los Angeles Activated Sludge Plant reported that they operate digesters at 120°F for improving sludge filterability. For some months the digesters have been loaded at 10 lbs. of solids/cu.ft./month.

JOHN LABOON, chief of the Allegheny Sewerage Authority, Pittsburgh, Pa. said that the primary sludge thickened to 15% solids by flotation in their studies had digested completely.

The question was put on the floor—"What percent volatiles in digested sludge constitutes good digestion?" It was answered by saying that it all depended upon the percent volatiles in the raw sludge. The volatiles in one well digested sludge might be only 42% whereas in another it might be 50%.

Factors in Oxygen Transfer

"BASIC FACTORS IN OXYGEN TRANSFER IN AERATION SYSTEMS" by A. T. Ippen and C. E. Carver, Jr., Dept. of Sanitary Eng., Mass. Inst. of Technology, Cambridge, Mass.

This paper, presented by Mr. Carver, reported on research which discloses the value of small air bubbles in aeration schemes where maximum oxygen uptake is desired with least depth of liquid above the diffusers. All of the studies indicated the probable economy of employing air for mixing but also the introduction of some pure oxygen for the maximum return per dollar spent in aeration for bio-oxidation. The size of the oxygen bubbles, in combination with the air, was not of great import.

W. E. DOBBINS, Assoc. Prof. San. Eng., N.Y. Univ. commented that regardless of the oxygen absorbed from air bubbles, the absorption of oxygen across the surface of aeration tanks has a distinct added value.

ROLF ELIASSEN, Prof. of San. Eng., M.I.T. pointed out that the practical application of the studies was to show engineers how to design the most efficient aeration systems. Further, that beyond a certain oxygen demand greatest economy would result from application of some straight oxygen.

With this Prof. DAN OKUN, Univ. of N.C., disagreed.

He did not think oxygen enrichment would be either feasible or economical. From his published work it is probable that Prof. Okum believes that straight oxygen undiluted with air should be used. Remarks by Prof. SAWYER of MIT would indicate that he is also of the opinion that air alone will not suffice when oxygen uptake rates exceed 60 to 65 ppm. of oxygen per hour.

What of Industrial Wastes?

"THE FUTURE OF INDUSTRIAL WASTES TREATMENT" was predicted by Hayse H. Black, Chief, Industrial Wastes Section, U.S.P.H.S., Cincinnati, Ohio, who envisioned many individual methods of attacking this problem.

Research was offered as the attack which will supply the most answers to the most unsolved questions. At present, Mr. Black reported, there are 48 research projects under way (with 38 devoted to industrial wastes studies) in 36 institutions. The expenditures on projects for investigating industrial waste have multiplied three times in the last ten years. In 1952, U.S. manufacturers spent $1.2 billion on research and other scientific research added another $1.9 billion. Process control, stream analyses, and treatment plant design and operation must receive corresponding attention.

Only within each industry can the basic solution to a waste problem be determined. A partial answer may be provided by reducing the quantity of polluting materials discharged. Treatment of waste at its source may reduce the complexity and cost of subsequent treatment. Process water may be treated and re-used with considerable economy. Certain wastes may be treated for the recovery of valuable products.

DR. F. W. MOHLMAN, Director, Div. of Labs, Sanitary District of Chicago, Chicago, Ill., discussed Mr. Black's paper. He urged that true research, *not* merely a search for a specific solution, should be followed. To be successful, future progress in industrial waste treatment will require something more than the application of what we now recognize as feasible.

Toxic Wastes Being Studied

"DETERMINING RISKS OF TOXIC SUBSTANCES IN WATER" was the topic of a paper presented by Edward J. Cleary, Executive Director and Chief Engineer, Ohio River Valley Water Sanitation Comm., Cincinnati, Ohio. He raised the question of toxic effects which may result from the continued consumption of water contaminated with industrial wastes; from the end-products of organic decomposition; from the chemical treatment of certain raw water supplies by chemical means.

State laws may be very positive in a negative fashion: "No toxic substance shall be discharged into a stream," is one such statement. But we have only meagre information as to what might be toxic to humans or animals, and practically no information as to the concentration of substances which affect degenerative diseases or the general well-being of individuals.

Mr. Cleary's organization has taken action in contracting with the Kettering Laboratory department of preventive medicine (University of Cincinnati) to undertake a toxicity evaluation of water pollutants. Work now under way is set up for a three-year period. Industry committees of the Commission will cooperate in the study. Progress is being made in a study of 180 chemicals.

GEORGE E. BURDICK, SR., Aquatic Biologist, N. Y. State Conservation Dept., Albany, N. Y., emphasized the value of data to result from such a study—but expressed the hope that toxicity data will not be used as the basis of critical standards for pollution control regulations. He noted that the U.S. drinking water standards must be revised downward if applied to fish life, since fish cannot be employed as a pollution standard if fish are considered more sensitive than humans.

Plant Maintenance Practice

"PREVENTIVE MAINTENANCE" is a program applicable to sewage treatment plants of all sizes, according to Francis A. Sanders, Lt. Col., U.S. A.F. Institute of Technology, Wright-Patterson Air Force Base, Ohio.

As essential requirements of a preventive maintenance program, he listed: training personnel in maintenance procedures; a schedule for servicing equipment; assigned responsibility for maintenance; and program supervision. A simple record system provides the essential basis of the program, and enables existing personnel to be most effectively utilized.

KERWIN L. MICK, Supt. and Chief Engr., Minneapolis St. Paul Sanitary District, Minneapolis, Minn., discussed the paper and cited experience justifying the value of preventive maintenance practices. As an example, he noted the long service record of 5.5 miles of chain in the settling tanks at his plant; replacement of worn links would have cost $10,000, but turning the chain and replacing wearing parts in the past year cost only $1,000. Corrosion and resultant electrical failure in humid locations has been prevented by installing bulkheads and a small continuously operated fan to maintain dry conditions. Mr. Mick noted that 14 per cent of the total plant operating and maintenance cost is allocated to *preventive* maintenance, and that the per cent of cost so spent is increasing as the plant becomes older.

Guy E. Griffin Appointed Deputy Public Works Commr. of Westchester County

Mr. James C. Harding, Commissioner of Public Works, Westchester County, New York, has announced the appointment of Guy E. Griffin to be a Deputy Commissioner in charge of its Sewer Division. His work will include supervision over the operation of the existing four County Sewage Treatment Plants and trunk sewerage system and also over the design and construction of an extensive program of sewerage and treatment plant construction, including a fifteen mgd plant under construction in New Rochelle and a fifty mgd plant to be built in Yonkers.

Mr. Griffin, after graduation from the University of Maine in civil engineering, obtained his Master's degree in sanitary engineering from Harvard. Following several years with Metcalf and Eddy, consulting engineers, Boston, Mass., he became sanitary engineer for Greenwich, Conn., where he was responsible for improving the operation of their several sewage treatment plants.

During World War II, as a Reserve Officer, he was assigned at various times to the Constructing Quartermaster Sanitary Corps, and Corps of Engineers. Following release from active duty as a Lieutenant-Colonel, Griffin spent a year in Honduras, C. A., as Chief Engineer in that country for the Institute of Inter-American Affairs on health and sanitation projects. On his return he became associated with the American Cyanamid Company, dealing with industrial water supply problems at their various plants and later became head of the industrial waste disposal section of their Central Engineering Division.

Sewage Construction Contracts Continue to Increase

Construction contracts for 155 projects to aid in the Nation's stream pollution abatement efforts were awarded during the third quarter of 1953, the Public Health Service of the Dept. of Health Education and Welfare has reported. The contracts totaled $38 million and covered 87 new plants and 68 additions, enlargements, or improvements to existing plants.

Of the 87 new plants, costing $24.6 million, seven were for locations of more than 20,000 population, and accounted for 60 per cent of the total new plant cost. More than half of the new plants will serve fewer than 5,000 population. The totals for the first nine months of 1953 are about 20 per cent higher than for the comparable period of 1952.

"Even if your wife does work at the filter-plant, how d'ya know she'll get that note saying we're gonna stay out here until they they start to bite?"

Little Rock's "Super" Makes Front Page Again

The following appeared on the front page of a Little Rock, Ark. paper.

Wouldn't You Know It?

"Yesterday the Little Rock Water Department began bombarding customers with warnings that their water pipes might freeze with the night's approaching cold weather.

Newspapers carried the warnings, as did a number of the city's radio stations. Residents were told to either cut off their water supply or leave a trickle run from each faucet.

Last night the cold weather arrived. And, whose pipes do you think froze? Those in the home of Waterworks Manager Leslie A. Jackson, the very man who issued the warnings a few hours earlier."

N.B.—In an argument the best weapon to hold is your tongue.

The Curse of Low Water Rates: Can We Break It?

"An Open Letter from"--One Water Works "Super" to Another

Dear Bill:

I missed seeing you at this year's meeting of our AWWA. Section—Too busy?—Who's kidding whom? You and I know that it's a case of not enough money in water works superintendents' pockets and not enough funds in the coffers of water departments that keeps many of us from attending these meetings.

This matter of too little money, both for ourselves and our water departments is not simply one of what inflation has done to the dollar. More important, both to us, our fellow employees, and to our departments are the low rates that still prevail in most municipalities.

I got to thinking seriously about this problem last spring when I heard L. R. Howson of Chicago, one of the smartest men in the water-works field, say at the AWWA meeting in Grand Rapids that, "All water service is cheap. Over 50 per cent of all water consumers in the U.S. are paying less than 1½ cents per capita per day for water service." He then pointed out that an increase of only a half cent a day per person would increase a water utility's income by one third, and this fraction of a cent per day can often "spell the difference between mediocre and excellent service."

He could have said, if water supply service is put on a profit making basis salaries of water works personnel could be increased—and that water works salaries would not lag so far behind the inflation spiral, and behind other municipal employees, firemen, policemen and teachers for example, Of course, this low pay scale naturally does not attract promising young blood in our profession. I heard AWWA's Harry Jordan say at a meeting recently, that a survey of 37 cities in one state showed that one out of five superintendents was appointed to his job without any previous water works training or education, and one out of four superintendents did not even have a high school education.—Hmmm!

Mr. Jordan thinks that if more municipal water utilities were governed by Boards or Commissions, the water works industry could and would attract and hold trained and experienced men. He's probably right, because a Commission or a Board usually has enough sense to raise rates for water to where management and operation (including salaries) is on a proper level.

How Mediocre Is Our Service?

As I said, it isn't just that our salaries could be increased, but as Mr. Howson pointed out "mediocre service could be changed to excellent service." Just how mediocre service is, generally, was indicated by some figures Harry Jordan gave before the Fla. Section meeting. In a survey made by the AWWA office, this past summer, it was found that 20% of the water supplies needed more supply, either ground or surface supplies; 12% were short of water treatment facilities; 7% were short on raw water pumping equipment. But, here was the most telling circumstance: Almost 50% could not meet the customer demands for water in outlying areas and had to restrict water use at some time.

That just means one thing. Right now, we need more distribution system and production capacity; *and*, we're going to need even more. Jordan went on to say that by 1975, the average city must provide 142 per cent of the 1950 utility capacity to meet average demands. And to meet peak demands in 1975 a city will have to provide 235 per cent of the 1950 capacity. That doesn't even consider the increase in demands for industry. Remember, too, that Jordan was talking about the *average* city. What about those fast growers?—So, how do we meet these ever increasing demands which will relentlessly march on us for the next two decades?

Planning and construction programs on a long range basis is the only answer, but both of these require ample funds; more funds per unit of capacity than has been spent before. Who has those funds, and how are you going to get them out of the low rates we are now charging for water?

A Crusade Needed

"How do we get higher rates?"—Jordan said, "We must have a crusade in the water industry; we *must* meet the needs, wishes, and demands of the people in a way for which they are willing to pay if given a chance to understand why they should pay for it." Right here and now, I am joining that crusade and I hope you will too. Now, this brings me to the point of this letter.

At one of the AWWA section meetings I was talking to Harvey Howe, about this matter of low rates. Harvey, as you know, is a smart engineer and is to be the new Vice-President of the Water & Sewage Works Mfgrs. Assn. He came up with an idea that should strike many of us as being excellent.

Here is what Harvey so well said—(1) low rates are a prime curse of the water works industry; (2) continued expansion of water utilities is a necessity; (3) proper expansion is possible only if the rates are high enough; (4) our customers don't know enough about our problems to care, although they would like to get improved service.

Obviously, the place to start on these problems is to educate the public, but how? We can't do it by talking to ourselves. We can't do it by writing articles for the Journal and the technical magazines. In a popular manner we've got to get our story over to the public at large! Of course, the public relations programs sponsored and fostered by AWWA are a great help, but they are not enough! Well, here's where Harvey Howe came up with THE idea. Harvey said that inasmuch as all manufacturers of equipment will benefit by these expansion efforts which are so necessary, why shouldn't the WSWMA underwrite and sponsor a publicity program about the water works industry, its plight, its future, and its need for sound and higher water rates. This program would be aimed at the public through newspaper articles, (country-wide) and through the non-technical magazines which reach all over the country. It couldn't be done overnight; it would probably take several years. Neither could it be done for a few pennies. To be done right it has to be done on a broad scale.

I think it could be done, and I'd like to see it given a try. Harvey doesn't know that I'm promoting his idea but I wish you would write to him and tell him what you think of it.—Don't delay: JOIN THE CRUSADE!

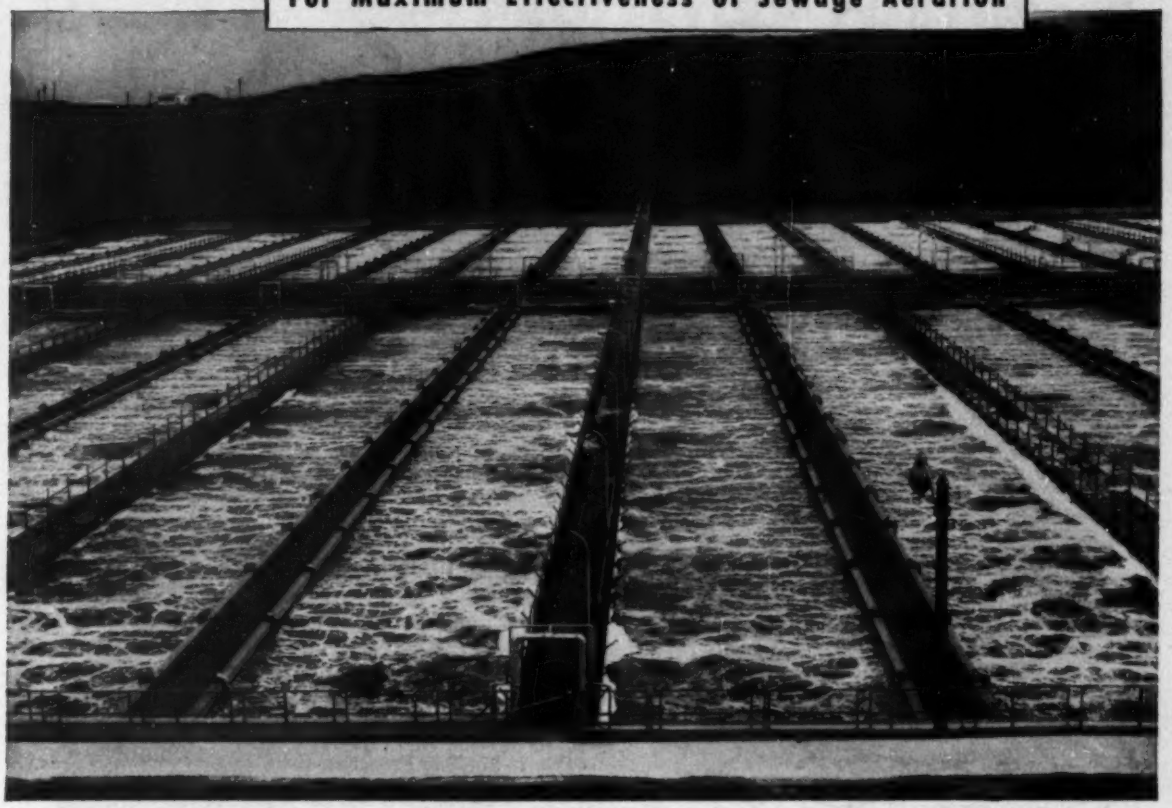
Yours,

"Sy."

CHICAGO SEWAGE EQUIPMENT

WIDE-BAND AIR DIFFUSION SYSTEMS

For Maximum Effectiveness of Sewage Aeration



Swing Diffusers installed for high rate aeration in 15 of 16 tanks at Los Angeles, California, Hyperion Sewage Treatment Plant. The City of Los Angeles, Board of Public Works and Metcalf & Eddy, Engineers

❶ Swing Diffusers are installed in over 300 Sewage Treatment Plants.

❷ Swing Diffusers are installed in 95% of all Sewage Treatment Plants requiring aeration built since 1940.

❸ Swing Diffusers are installed in such large cities as New York, Los Angeles, Chicago*, Philadelphia, Boston, Cleveland, Omaha, Syracuse, Columbus, Oklahoma City, Boise, Madison, Altoona, Indianapolis, Lansing, Charlotte, N. C., and many others.

Installed for channel aeration

❹ Swing Diffusers were installed in both new plants and in existing plants to increase aeration capacity and efficiency without construction of additional tanks.

❺ Swing Diffusers exclusively provide highest aeration capacity and accessibility of diffusers without interruption of aeration, making unnecessary the construction of stand-by tanks.

CHICAGO PUMP COMPANY

SEWAGE EQUIPMENT DIVISION

622 DIVERSEY PARKWAY — **CHICAGO 14, ILLINOIS**

Flush Kleen, Screw-Feller, Plunger Horizontal and Vertical Non-Clogs Water Seal Pumping Units, Samplers

Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors.

Check

Are You Using a COAGULANT with These Advantages?

✓ ① Coagulation over wide PH ranges, color, turbidity and manganese removal.

✓ ② Rapid floc formation and rapid settling.

✓ ③ Increased filter runs.

✓ ④ Quality effluent low in iron and aluminum.

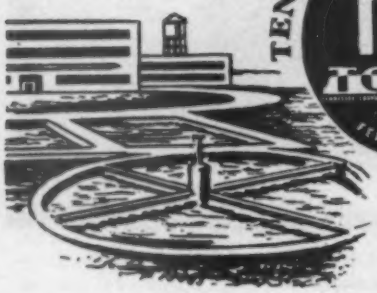
✓ ⑤ Excellent taste and odor control.

Water Treatment
Coagulation of surface or well waters. Aids taste and odor control. Effective in lime soda-ash softening. Adaptable to treatment of nearly all industrial water or wastes.

Sewage Treatment
Coagulation over wide PH range. Efficient operation regardless of rapid variations of raw sewage. Effective for conditioning the sludge prior to vacuum filtration or drying on sand beds.

TENNESSEE CORPORATION

Ferri-Floc
TC
FERRIC SULPHATE



SULPHUR-DIOXIDE
SO_2

SULPHUR-DIOXIDE
SULPHUR-DIOXIDE is effectively used for dechlorination in water treatment and to remove objectionable odors remaining after purification.

Free Literature!

Let us send you free literature on the above products. Send card or letter to Tennessee Corporation, 617-629 Grant Building, Atlanta, Ga.

COPPER SULPHATE

COPPER SULPHATE
COPPER SULPHATE will control about 90% of the microorganisms normally encountered in water treatment plants more economically than any other chemical.

TENNESSEE TC CORPORATION

617-29 Grant Building, Atlanta, Georgia

Meetings Scheduled

1954 JAN.	S	M	T	W	T	F	S
						1	2
	3	4	5	6	7	8	9
	10	11	12	13	14	15	16
	17	18	19	20	21	22	23
	24	25	26	27	28	29	30
	31						

1954 FEB.	S	M	T	W	T	F	S
		1	2	3	4	5	6
	7	8	9	10	11	12	13
	14	15	16	17	18	19	20
	21	22	23	24	25	26	27
	28						

1954 MAR.	S	M	T	W	T	F	S
		1	2	3	4	5	6
	7	8	9	10	11	12	13
	14	15	16	17	18	19	20
	21	22	23	24	25	26	27
	28	29	30	31			

APRIL	S	M	T	W	T	F	S
					1	2	3
	4	5	6	7	8	9	10
	11	12	13	14	15	16	17
	18	19	20	21	22	23	24
	25	26	27	28	29	30	

MAY	S	M	T	W	T	F	S
							1
	2	3	4	5	6	7	8
	9	10	11	12	13	14	15
	16	17	18	19	20	21	22
	23	24	25	26	27	28	29
	30	31					

JUNE	S	M	T	W	T	F	S
				1	2	3	4
	5	6	7	8	9	10	11
	12	13	14	15	16	17	18
	19	20	21	22	23	24	25
	26	27	28	29	30		

JULY	S	M	T	W	T	F	S
					1	2	3
	4	5	6	7	8	9	10
	11	12	13	14	15	16	17
	18	19	20	21	22	23	24
	25	26	27	28	29	30	31

AUG.	S	M	T	W	T	F	S
	1	2	3	4	5	6	7
	8	9	10	11	12	13	14
	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30	31				

SEPT.	S	M	T	W	T	F	S
				1	2	3	4
	5	6	7	8	9	10	11
	12	13	14	15	16	17	18
	19	20	21	22	23	24	25
	26	27	28	29	30		

OCT.	S	M	T	W	T	F	S
						1	2
	3	4	5	6	7	8	9
	10	11	12	13	14	15	16
	17	18	19	20	21	22	23
	24	25	26	27	28	29	30
	31						

NOV.	S	M	T	W	T	F	S
		1	2	3	4	5	6
	7	8	9	10	11	12	13
	14	15	16	17	18	19	20
	21	22	23	24	25	26	27
	28	29	30				

DEC.	S	M	T	W	T	F	S
				1	2	3	4
	5	6	7	8	9	10	11
	12	13	14	15	16	17	18
	19	20	21	22	23	24	25
	26	27	28	29	30	31	

Feb. 9-10—Portland, Me.
MAINE WATER UTILITIES ASSOCIATION. (Annual Meeting). Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Feb. 10-12—Indianapolis, Ind. *(Lincoln Hotel)*
INDIANA SECTION A.W.W.A. Sec'y, Geo. G. Fassnacht, 1330 W. Michigan St., Indianapolis 7, Ind.

Feb. 11-12—Columbus, Ohio *(Ohio State Univ. Campus)*
OHIO WATER CLINIC CONFERENCE. (3rd Annual Meeting). Director, Kenneth W. Cosens, Ohio State Univ., Columbus, O.

Feb. 15-19—Atlanta, Ga. *(Hotel Biltmore)*
AMERICAN SOCIETY CIVIL ENGINEERS. (Winter Meeting). Exec.-Sec'y, Wm. N. Carey, 33 W. 39th St., New York, N.Y.

Feb. 16—Newark, N.J. *(Essex House)*
NEW JERSEY SECTION A.W.W.A. (Winter Meeting). Sec'y, C. B. Tygert, P.O. Box 178, Newark, N.J.

Feb. 18—Boston, Mass. *(Statler Hotel)*
NEW ENGLAND WATER WORKS ASSOCIATION. (Monthly Meeting). Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Feb. 25-27—San Francisco, Calif. *(Fairmont Hotel)*
AMERICAN CONCRETE PIPE ASSOCIATION. Director, Howard F. Peckworth, 228 No. LaSalle Street, Chicago, Ill.

Mar. 10-12—Atlantic City, N.J. *(Traymore Hotel)*
NEW JERSEY SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Michael S. Kachorsky, P.O. Box 766, Manville, N.J.

Mar. 10-12—Baton Rouge, La. *(Louisiana State Univ.)*
WATER & SEWERAGE SHORT COURSE. Director, John H. O'Neill, Dept. of Health, New Orleans, La.

Mar. 17-19—Chicago, Ill. *(LaSalle Hotel)*
ILLINOIS SECTION A.W.W.A. Sec'y, Dewey W. Johnson, 122 So. Michigan Ave., Chicago, Ill.

Mar. 18—Boston, Mass. *(Statler Hotel)*
NEW ENGLAND SECTION A.W.W.A. Sec'y, Geo. G. Bogren, 14 Beacon St., Boston 8, Mass.

Mar. 18—Boston, Mass. *(Statler Hotel)*
NEW ENGLAND WATER WORKS ASSOCIATION. (Monthly Meeting). Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Mar. 18-19—Raleigh, N.C. *(North Carolina State College)*
THIRD SOUTHERN MUNICIPAL & INDUSTRIAL WASTE CONFERENCE. Conference Chairman, Dr. Nelson L. Nemerow, Dept. of Sanitary Engineering, N. C. State College, Raleigh, N.C.

Mar. 22-24—Little Rock, Ark. *(Marion Hotel)*
ARKANSAS WATER & SEWAGE CONFERENCE. Sec'y, Dr. Harrison Hale, Southern State College, Magnolia, Ark.

Mar. 22-26—Amherst, Mass. *(New England Field Training Center)*
SEWAGE TREATMENT WORKS OPERATORS SHORT COURSE. Director, A. A. Robertson, State Dept. of Health, Boston, Mass.

(*Continued on page* 88A)

YOU CAN *Specify* MINIMUM MAINTENANCE COSTS WITH *Amercoat* PROTECTIVE COATINGS

ONLY AMERCOAT PROVIDES YOU WITH

The most complete line of corrosion resistant coatings available anywhere

Field service backed by an organization SPECIALIZING in corrosion control

The service life of your equipment—the efficiency of your production schedules — the ultimate value of your investment and maintenance dollars — all are vitally dependent on the continuing performance of the protective coatings specified in your plant. Thus, success or failure of your coatings can mean the difference between tremendous losses or substantial savings.

To assure coating performance that provides long-lasting, low-cost protection, two steps are absolute essentials, right from the start. You need the right coating for each specific exposure, and it must be applied properly if it is to yield maximum benefit.

AMERCOAT ELIMINATES THE GUESSWORK—MINIMIZES MAINTENANCE COSTS

First of all, AMERCOAT provides the right coating for the particular problem. From the complete AMERCOAT line, it is possible to provide specific coatings for specific exposures to achieve specified protective performance.

In addition, you receive the added value of AMERCOAT's conscientious service follow-through backed by an organization SPECIALIZING in industrial corrosion control. With the assistance and on-the-spot advice of a trained representative, you get the best possible application through proper attention to surface preparation and correct coating techniques.

Investigate AMERCOAT now. It's your surest way to effective, long-term corrosion control. An experienced representative is near you to serve you. For complete details write today.

Amercoat CORPORATION
4809 Firestone Blvd., South Gate, Calif.

CHICAGO, ILLINOIS
KENILWORTH, NEW JERSEY
JACKSONVILLE, FLORIDA
HOUSTON, TEXAS

It's new... and better!
the WELSBACH Kitson
CORPORATION TAPPING MACHINE
For installing corporation stops under pressure, this is the safest, surest, most easily-handled and, without sacrifice of inherent strength, the lightest corporation tapping machine ever made. It is so compact that it is ideal for making taps where space is limited.
It is the new Welsbach-Kitson Corporation Tapping Machine—an improved model of the popular Smith-Shelly Tapping Machine, equipped now with a flat chain and adaptor that provides positive non-slip pipe-gripping action . . . which makes it an even better machine than before. And in keeping with the simplicity of operation of this popular machine, the new adaptor, which gives positive pipe-gripping action, is easy to set and helps speed the operation.
with the new POSITIVE, NON-SLIP PIPE-GRIPPING ACTION!
THE WELSBACH CORPORATION
Kitson Valve Division
1500 Walnut Street, Philadelphia 2, Pa.

(*Continued from page 86A*)

Mar. 29-31—Greenville, S.C. *(Poinsett Hotel)*
SOUTHEASTERN SECTION A.W.W.A. (25th Annual Meeting). Sec'y, N. M. deJarnette, 245 State Office Bldg., Atlanta 3, Ga.

Apr. 7-9—Emporia, Kan. *(Broadview Hotel)*
KANSAS SEWAGE WORKS ASSOCIATION. Sec'y, Dwight F. Metzler, State Board of Health, Marvin Hall, Room 2, Univ. of Kansas, Lawrence, Kan.

Apr. 7-9—Emporia, Kan. *(Broadview Hotel)*
KANSAS SECTION A.W.W.A. Sec'y, Harry W. Badley, 119 West Cloud, Salina, Kan.

Apr. 12-14—Toronto, Ont. *(Royal York Hotel)*
CANADIAN SECTION A.W.W.A. Sec'y, A. E. Berry, Ontario Dept. of Health, Toronto, Ont.

Apr. 14—Norway, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Apr. 22-23—Watertown, N.Y. *(Woodruff Hotel)*
NEW YORK SECTION A.W.W.A. (Annual Spring Meeting. Registration evening of 21st). Sec'y, Kimball Blanchard, 50 West 50th Street, New York, N.Y.

Apr. 22-23—Lincoln, Neb. *(Cornhusker Hotel)*
NEBRASKA SECTION A.W.W.A. Sec'y, E. Bruce Meier, University of Nebraska, Lincoln, Neb.

Apr. 22-24—Tucson, Ariz. *(Santa Rita Hotel)*
ARIZONA SECTION A.W.W.A. Sec'y, M. V. Ellis, Supervisor Sewage Treatment Plant, Phoenix, Ariz.

Apr. 22—Bozeman, Mont. *(Hotel Baxter)*
MONTANA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Harry W. Taylor, Morrison & Maierle, Inc., Helena, Mont.

Apr. 23-24—Bozeman, Mont. *(Baxter Hotel)*
MONTANA SECTION A.W.W.A. Sec'y, A. W. Clarkson, State Board of Health, Helena, Mont.

Apr. 23-24—Boston, Mass. *(Hotel Somerset)*
NEW ENGLAND SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Stephen M. Hurley, State Dept. of Health, Providence, R.I.

Apr. 29-30—Frederick, Md. *(Hotel Francis Scott Key)*
MARYLAND-DELAWARE WATER & SEWAGE ASSOCIATION. Sec'y, W. M. Bingley, 2411 N. Charles St., Baltimore 18, Md.

May 5-8—Sacramento, Calif. *(Hotel Senator)*
CALIFORNIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sam A. Weed, Room 315, City Hall, Oakland, Calif.

May 10-12—Lafayette, Ind. *(Purdue University)*
NINTH PURDUE INDUSTRIAL WASTE CONFERENCE. Director, Prof. Don E. Bloodgood, Purdue University, Lafayette, Ind.

May 23-28—Seattle, Wash. *(Exhibits and Technical Sessions—Auditorium)*
AMERICAN WATER WORKS ASSOCIATION. (74th Annual Convention). Exec.-Sec'y, Harry E. Jordan, 521 Fifth Ave., New York 17, N.Y.
All reservations will be cleared through A.W.W.A. office.

June 9—Lubec, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

June 14-18—Chicago, Ill.
AMERICAN SOCIETY FOR TESTING MATERIALS. Sec'y, Raymond E. Hess, 1916 Race St., Philadelphia 3, Pa.

June 14-19—Atlantic City, N.J. *(Chalfonte Haddon Hall)*
AMERICAN SOCIETY CIVIL ENGINEERS. Exec.-Sec'y, Wm. N. Carey, 33 West 39th St., New York, N.Y.

June 16-18—Allentown, Pa.
PENNSYLVANIA SECTION A.W.W.A. Sec'y, L. S. Morgan, State Dept. of Health, Greensburg, Pa.

June 22—Boonton, N.J. *(The Knolls Golf Club)*
NEW JERSEY SECTION A.W.W.A. (Summer Outing). Sec'y, C. B. Tygert, Box 178, Newark, N.J.

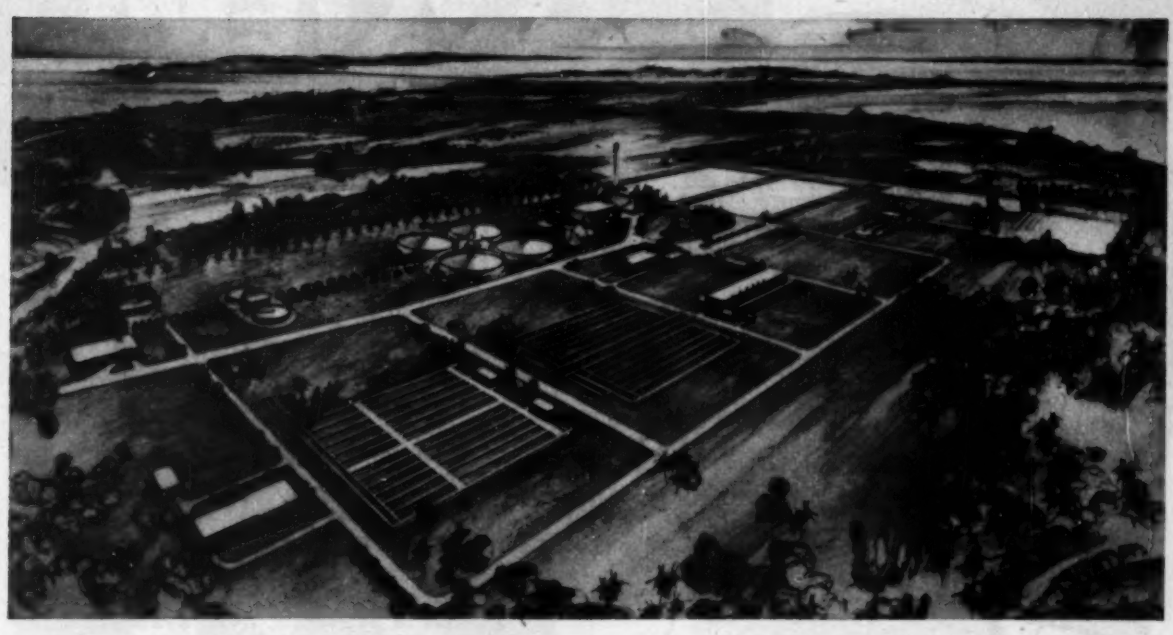
June 24-26—Richmond, Ind.
CENTRAL STATES SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, A. Paul Troemper, 2029 Bates Avenue, Springfield, Ill.

(*Continued on page 91A*)

THE LEADER IN SEWAGE SLUDGE DISPOSAL

specified for Miami Project

Two C-E Raymond Incinerators will be used at Miami's new sewage treatment plant, located on Virginia Key, just across Biscayne Bay from Miami proper. Treatment plant design was by Metcalf and Eddy, a member of Miami Sewer Project Associates. Other members are Rader Knappen Tippetts Engineering Co. and Maurice H. Connell & Associates, Inc.



In keeping with the thoroughly modern equipment to be used in this new plant, the filtered sludge will be processed in two C-E Raymond Flash Drying and Incineration Systems. The sludge will be dried from 75% to 8% moisture, and then incinerated to a sterile ash. High-temperature deodorization will eliminate odors from the stack gases. Each C-E Raymond Flash Dryer will process 4½ tons of filter cake per hour, which is equivalent to an evaporation rate per unit of 6,576 pounds.

The system can be easily adapted to the production of fertilizer by the addition of dried sludge handling equipment. This flexibility is just one of the many reasons why the aggregate capacity of C-E Raymond Equipment installed, under construction or on order, is higher than all other heat methods combined.

What has been right for so many other communities will be right for you, too. Let a C-E Raymond specialist demonstrate how efficiently and economically this leading system can end your sludge disposal problems.

B-698

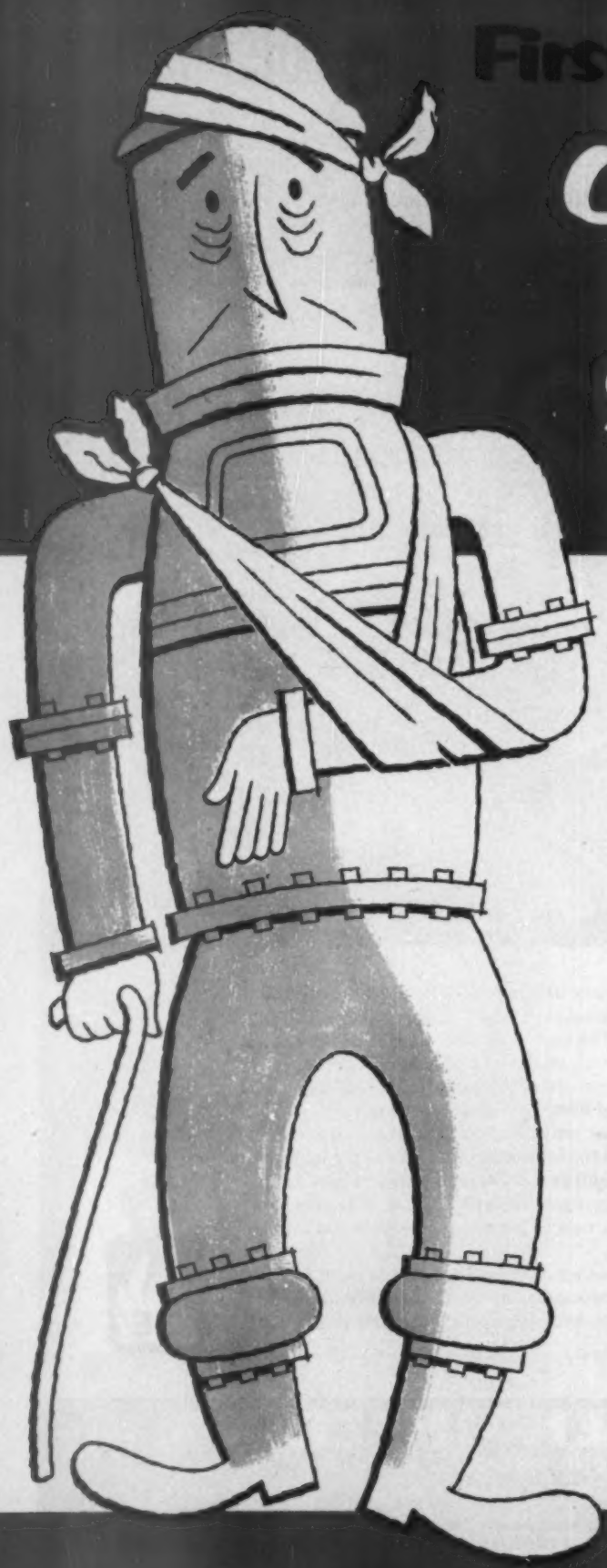
COMBUSTION ENGINEERING, Inc.

RAYMOND DIVISION

1315 North Branch Street, Chicago 22, Illinois

Western Office: 510 W. Sixth St., Los Angeles 14, Calif. • Eastern Office: 200 Madison Ave., N. Y. 16, N. Y.

ALSO FLASH DRYING AND INCINERATION SYSTEMS FOR INDUSTRIAL WASTE DISPOSAL



First Aid for CRIPPLED WATER SYSTEMS

■ Are your water pumps past their prime? Wells showing signs of internal disorders? Better call in Layne for a checkup. Layne water supply specialists can get crippled water systems off their crutches in a hurry.

Emergency Repairs—Layne has the equipment, repair parts and skill to make emergency repairs in minimum time. Field crews are qualified to pull and repair all makes of vertical turbine pumps.

Water Well Acidizing—This often adds years to the life of failing water wells. It may be the answer to your water supply problem.

Layne repair and maintenance service, backed by 72 years of experience, keeps water supplies up and costs down. Get complete details now from your nearest Layne Associate Company. Or write Layne & Bowler, Inc., Memphis 8, Tenn.

Water Wells
Vertical Turbine Pumps

WATER TREATMENT

Layne Associate Companies Throughout The World

(*Continued from page 88A*)

Aug. 11—Bingham, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Aug. 23-25—State College, Pa. *(College Dormitories)*
PENNSYLVANIA WATER WORKS OPERATORS ASSOCIATION. Sec'y, R. R. Kountz, Pennsylvania State College, State College, Pa.

Aug. 25-27—State College, Pa. *(College Dormitories)*
PENNSYLVANIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, B. S. Bush, Dept. of Health, Kirby Health Center, Wilkes-Barre, Pa.

Sept. 9-10—Montauk, N.Y.
NEW YORK SECTION A.W.W.A. (Annual Fall Meeting). Sec'y, Kimball Blanchard, 50 West 50th Street, New York, N.Y.

Sept. 15-17—Muskegan, Mich. *(Occidental Hotel)*
MICHIGAN SECTION A.W.W.A. Sec'y, T. L. Vander Velde, Dept. of Health, Lansing 4, Mich.

Sept. 20-22—Nashville, Tenn. *(Andrew Jackson Hotel)*
KENTUCKY-TENNESSEE SECTION A.W.W.A. Sec'y, J. Wiley Finney, Jr., 420 6th Ave., N., Nashville, Tenn.

Sept. 20-22—Nashville, Tenn. *(Andrew Jackson Hotel)*
KENTUCKY-TENNESSEE INDUSTRIAL WASTES & SEWAGE WORKS ASSOCIATION. Sec'y, R. Paul Farrell, 420 6th Ave., N., Nashville 3, Tenn.

Sept. 22-24—Dayton, Ohio *(Biltmore Hotel)*
OHIO SECTION A.W.W.A. Sec'y, M. E. Druley, Dayton Power & Light Co., Wilmington, Ohio.

Sept. 26-28—Jefferson City, Mo. *(Governor Hotel)*
MISSOURI SECTION A.W.W.A. Sec'y, Warren A. Kramer, State Office Bldg., Jefferson City, Mo.

Sept. 28-30—Green Bay, Wis. *(Northland Hotel)*
WISCONSIN SECTION A.W.W.A. Sec'y, Leon A. Smith, City Hall, Madison 3, Wis.

Oct. 4-6—Poland Spring, Me. *(Poland Spring House)*
NEW ENGLAND WATER WORKS ASSOCIATION. (73rd Annual Convention). Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Oct. 13—Brunswick, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Oct. 18-22—New York, N.Y. *(Statler Hotel)*
AMERICAN SOCIETY CIVIL ENGINEERS. (Annual Meeting). Exec.-Sec'y, Wm. N. Carey, 33 West 39th St., New York, N.Y.

Oct. 11-14—Cincinnati, O. *(Netheriand Plaza Hotel)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSOCIATIONS. (27th Annual Convention). Exec-Sec'y, W. H. Wisely, 325 Illinois Bldg., Champaign, Ill.

(In conjunction with)

OHIO SEWAGE & INDUSTRIAL WASTES TREATMENT ASSOCIATION. Sec'y, Ward E. Conard, 301 Ohio Departments Bldg., Columbus 15, Ohio.

Oct. 11-15—Buffalo, N.Y. *(Statler Hotel—Tech. Sessions, Memorial Auditorium)*
AMERICAN PUBLIC HEALTH ASSOCIATION. (Annual Meeting). Sec'y, Mrs. W. R. Walsh, A.P.H.A., 1790 Broadway, New York, N.Y.

Oct. 13-15—Cedar Rapids, Iowa *(Roosevelt Hotel)*
IOWA SECTION A.W.W.A. Sec'y, H. V. Pedersen, Municipal Bldg., Marshalltown, Iowa.

Oct. 17-20—El Paso, Texas *(Cortez Hotel)*
SOUTHWEST SECTION A.W.W.A. Sec'y, Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

(*Continued on page 92A*)

Member of a Great Pump Family

There is a PUMP by Aurora for every pump job.
TYPE-OD
Aurora Horizontally Split-Case, Double Suction, Single Stage Centrifugal Pump.
For general water supply for municipalities, industries, office buildings, institutions—also—for handling liquids, chemical solutions, oils etc., in a wide variety of industries. Write for Bulletin 105-M for further details.

DISTRIBUTORS IN PRINCIPAL CITIES

AURORA Always PUMPS — AURORA PUMP COMPANY

DIVISION OF THE NEW YORK AIR BRAKE COMPANY

68 Loucks Street, Aurora, Illinois

NO "CRYSTAL BALL" NEEDED

Detectron "505" PIPE DETECTOR

takes all guesswork out of Pipe Detection

◀ DETECTS, TRACES and CENTERS PIPE, CABLE, ETC.
◀ ESTIMATES EXACT DEPTH
◀ SEPARATES PARALLEL PIPE, CABLE and CONDUIT

A crystal ball might be one way to locate buried pipe or cable at an excavation site. But . . . a *better, safer* and *more efficient* way is to use the new, improved Detectron "505" that accurately pinpoints the exact length, depth and location. *Stop guessing —and be sure!*

Send today for FREE Catalog No. 57

THE Detectron CORPORATION

5420 VINELAND AVE., NO. HOLLYWOOD, CALIF.

(*Continued from page* 91A)

Oct. 19-22—Atlantic City, N.J. *(Chalfonte Hotel)*
PENNSYLVANIA WATER WORKS ASSOCIATION. Sec'y, L. S. Morgan, State Department of Health, Greensburg, Pa.
Oct. 24-27—Birmingham, Ala. *(Tutwiler Hotel)*
ALABAMA-MISSISSIPPI SECTION A.W.W.A. Sec'y, Charles W. White, State Department of Health, Montgomery, Ala.
Oct. 26-29—Long Beach, Calif. *(Wilton Hotel)*
CALIFORNIA SECTION A.W.W.A. Sec'y, John C. Luthin, 113 Laurent St., Santa Cruz, Calif.
Oct. 27-29—Baltimore, Md. *(Hotel not selected)*
CHESAPEAKE SECTION A.W.W.A. Sec'y, Carl Lauter, 6955 33rd St., Washington 5, D.C.
Nov. 3-5—Richmond, Va. *(Jefferson Hotel)*
VIRGINIA SECTION A.W.W.A. Sec'y, J. P. Kavanagh, 915 Colonial-American Bank Bldg., Roanoke 11, Va.
Nov. 4-6—Atlantic City, N.J. *(Madison Hotel)*
NEW JERSEY SECTION A.W.W.A. Sec'y, C. B. Tygert, Box 178, Newark 1, N.J.
Nov. 8-9—Huntington, W. Va. *(Hotel Prichard)*
WEST VIRGINIA SECTION A.W.W.A. Sec'y, Harry K. Gidley, State Dept. of Health, Charleston 5, W. Va.
Nov. 7-10—St. Petersburg, Fla. *(Soreno Hotel)*
FLORIDA SECTION A.W.W.A. Sec'y, Wm. W. Aultman, Box 316, Coconut Grove Sta., Miami 33, Fla.
Nov. 11-12—McCook, Neb. *(Keystone Hotel)*
NEBRASKA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Paul W. Mousel, 602 West B. Street, McCook, Neb.
Nov. 28-Dec. 3—New York, N.Y. *(Statler Hotel)*
AMERICAN SOCIETY OF MECHANICAL ENGINEERS. (Annual Meeting). Sec'y, C. E. Davies, 29 West 33rd St., New York, N.Y.
Dec. 8—Winthrop, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Rx FOR CORROSION...

You don't need a specialist to *recognize* Corrosion. But you do need one to treat it successfully. The skill required to achieve complete corrosion control comes only from the knowledge and experience gained through years of practical application.

Recognition of that fact is one reason more and more people are turning to E.R.P. for assistance on corrosion problems — one reason that thousands of buried or submerged steel structures of all types have been completely protected against corrosion by E.R.P. engineers. Corrosion specialists *for over 17 years*, these men are highly trained and well equipped to help you with *your* corrosion problem. Write for full information today.

COMPLETE CATHODIC PROTECTION SERVICE
DESIGN
ENGINEERING
MAINTENANCE
INSTALLATION
EQUIPMENT

ELECTRO RUST-PROOFING CORP. (N. J.)
BELLEVILLE 9, NEW JERSEY
REPRESENTED IN PRINCIPAL CITIES IN THE UNITED STATES

E-27

Water Rates Are Rising

Los Angeles, Calif.

The Los Angeles City Council has boosted city water rates to increase water revenues about $3,825,000 (which is 17.5 per cent) annually for the city's municipally owned water system.

The city's Department of Water and Power last year had water revenues of about $22 million. Reason given for the hike, which will add about 67 cents to the average monthly water bill, was to offset increased operating costs and continued expansion of the water system due to continued population growth. A spokesman from the department noted this is the system's first water rate hike in 15 years.

South Pittsburgh, Pa.

The South Pittsburgh Water Company has won State Superior Court's approval of a 35 per cent rate increase which has been effective since September 1952. A 10-page opinion held that the Public Utility Commission acted fairly in permitting the $800,000 annual revenue boost.

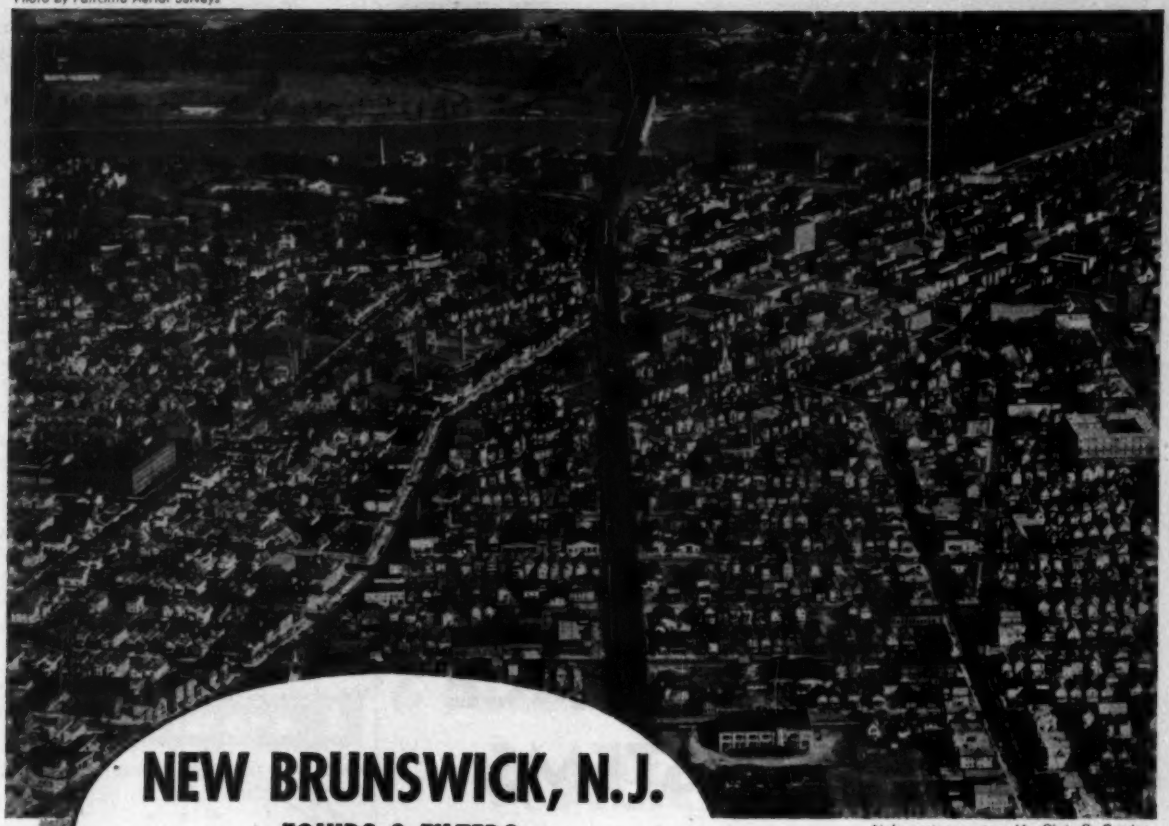
Phillipsburgh, N. J.

An application for permission to increase rates has been filed with the New Jersey Public Utilities Commission by the Peoples Water Co. The company supplies water for users in Phillipsburg and parts of Lopatcong and Pohatcong townships.

If the application is granted, customers without meters will pay $4 instead of $3.25 for each three-month period. The minimum for subscribers

(*Continued on page* 94A)

Photo by Fairchild Aerial Surveys



NEW BRUNSWICK, N.J.

EQUIPS 8 FILTERS with POROUS UNDERDRAINS

*Information courtesy Mr. Chris C. Condon, Superintendent, New Brunswick Water Dept.

*A dozen years ago New Brunswick had mushroom strainers in all their gravity filters. They also had an acute case of sand clogging. Dangerously high pressures were often needed to clear the sand. And at best, backwashing was uneven. Mudballs and upset gravel were constant problems.

In 1943, they started to modernize their filters. They installed porous underdrains, using ALOXITE® aluminum oxide plates—one filter in 1943; one in '44; two in '46; two in '48; and two in '50. Today, all their filters have ALOXITE underdrain plates, and their previous difficulties have been eliminated. Backwashing now takes five minutes and only 5000 gallons of wash water per unit, where it used to take 12 minutes and twice as much water.

Our congratulations to New Brunswick on a well planned and executed program of modernization. The low operating and maintenance costs of their porous-plate underdrains should be tremendous assets for years to come.

May we send you our popular booklet on porous media? Its 56 pages cover all fields of filtration and diffusion. No obligation, of course. Simply write to the address below.

CARBORUNDUM
Registered Trade Mark

Dept. M-24, Refractories Division

The Carborundum Company, Perth Amboy, N. J.

6 Reasons why

PALMER SURFACE WASH SYSTEMS

are specified by water works engineers

1. **Prevent Sand Beds From Cracking.**
2. **Eliminate Mud Balls.**
3. **Save Wash Water.**
4. **Lengthen Filter Runs.**
5. **Higher Rates of Filtration.**
6. **Better Tasting Water.**

Write today for Bulletin 451 and a list of water purification plants that have gone modern.

STUART CORPORATION
516 N. CHARLES ST., BALTIMORE 1, MD.

(*Continued from page 92A*)

with meters would be increased from $3.25 to $4.05 for 9,750 gallons of water over a three-month period.

The present rates have been in effect without change or petitions for increases since 1922, the company said.

Pickups from Purdue's "Sanitary Engineering News"

Don E. Bloodgood, Editor

The major units in the University of Florida's 35 unit pilot sewage treatment plant include a primary sedimentation tank and an Imhoff tank for primary treatment, and an Aero-Accelator. Six trickling filters utilizing such media as Birmingham slag, Chattahoochee River gravel, Brooksville limestone, waste wood blocks, and waste wood slats, plus eight sand filters containing various grades of sand, are arranged so that all can be dosed with the same influent. Two open digestion tanks with sand drying beds and a 1 ft. x 1 ft. vacuum filter provide facilities for the study of the treatment of solids.

* * *

Fluorides can be removed from water by passage through activated superphosphate of lime.

* * *

Escherichia coli have been found to reduce nitrates to nitrites.

* * *

The British Waterworks Association is setting up the Water Research Association, a company limited by guarantee to carry out research for the water supply industry.

* * *

Meritorious awards for sewage treatment work in cities: over 25,000

"The Commissioner says he has fewer complaining callers this way."

went to D. O. Bender of Indianapolis, under 25,000 went to Jesse Behle of Washington. The award for outstanding contributions to the sewage works program went to W. E. Ross of Richmond. Congratulations, men!

Industries in W. Va. Can Commandeer Land for Waste Treatment

An interesting law has been put on the books by the State of West Virginia. Chapter 145 of the Acts of 1953 invests industries with the right to commandeer land by eminent domain, if such is necessary, for providing waste treatment facilities. Such right becomes effective after application is made to the State Water Commission and the Commission enters an order on the applicant which order finds that the use of the land to be taken is necessary in the control of pollution, and directing the industrial plant to use such land within a specified time and solely for the purpose of pollution curtailment.

Dresser Appoints Sales Representative

Dresser Manufacturing Division of Bradford, Pennsylvania has announced the appointment of Thomas L. Vance as sales representative for Southern California, Nevada and Arizona. His headquarters will be in Los Angeles.

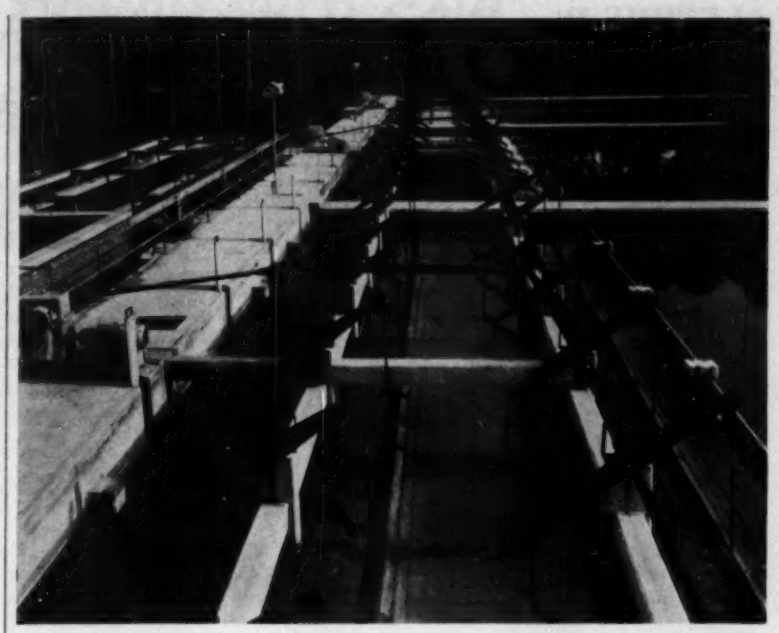
A 1950 graduate of Texas Christian University, Mr. Vance was formerly employed by the South Chester Tube Company in Ft. Worth. He joined Dresser in September 1953.

High-Capacity Chlorinator Offers Direct, Visible Flow Measurement

201

Fischer & Porter Company, Hatboro, Pa., announces a new line of high capacity chlorinators which offer unique features of simplicity,

(Continued on page 96A)



6 Reasons why

WALKING BEAM FLOCULATION

is now specified by water works engineers

1. **Eliminates troublesome underwater bearings.**
2. **Eliminates expensive dry well construction.**
3. **All bearings accessible for inspection and lubrication.**
4. **Produces quick responsive floc formation.**
5. **Longer filter runs.**
6. **A saving in alum.**

Write today for Bulletin 451 and a list of water purification plants that have gone modern.

STUART CORPORATION
516 N. CHARLES ST., BALTIMORE 1, MD.

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

M-SCOPE Pipe Finder

LIGHTWEIGHT MODEL

One Man Operation

HIGHLY EFFICIENT

IMMEDIATE SHIPMENT

Catalog No. 25G On Request

JOSEPH G. POLLARD CO., INC.

Pipe Line Equipment

New Hyde Park **New York**

(*Continued from page 95A*)

wide operating range, and dependability for municipal and industrial chlorination.

Called the Figure 1052 Ratachlor, the new chlorinators—which can handle up to 6000 ppd with either manual or automatic proportioning—are designed about an all-vacuum, solution feed system. Simple, solid, corrosion-resistant components reduce requirements for maintenance and spare parts to a minimum. A direct-reading flow meter, visible through a window at the front of the cabinet, enables an operator to spot any change in chlorine flow rate the instant there is an adjustment in chlorine rate valve.

Vacuum created by the water ejector insures positive, direct flow of chlorine through the chlorinator system. The pressure of dry chlorine gas entering the system is reduced to 20-in. water column vacuum by the vacuum regulator before passing through a wide-range Fischer & Porter Flowrator meter calibrated for direct reading. Chlorine next goes through the rate valve which can be maintained at the desired setting by either direct or remote means. Flow through the valve is kept constant by a differential pressure regulator. In the ejector assembly, gas is mixed with water and the solution goes on to the point of injection. The fact that the system's vacuum regulator, differential pressure regulator and vacuum breaker have interchangeable parts helps account for the economy in the number of spare parts it requires.

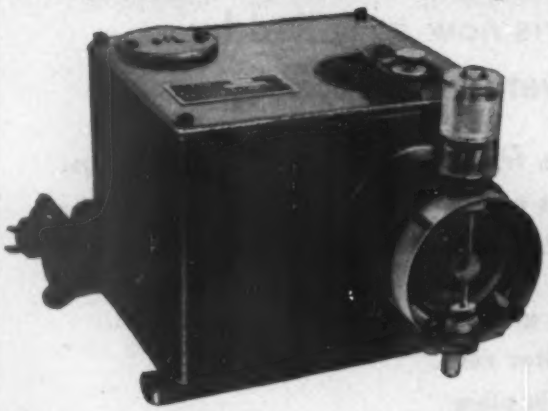
Moore Elected Vice President-Sales at Pittsburgh Coke

Pittsburgh Coke & Chemical Company, Pittsburgh, Pa. has announced that at a recent meeting of the Board of Directors Mr. Robert M. Moore was elected Vice President in charge of Sales.

Mr. Moore has been with the company since 1942 and has served in the capacity of General Manager-Sales for the last seven years. In his position as Vice President-Sales, Mr.

(*Continued on page 98A*)

PRECISION Chemical Pumps



for

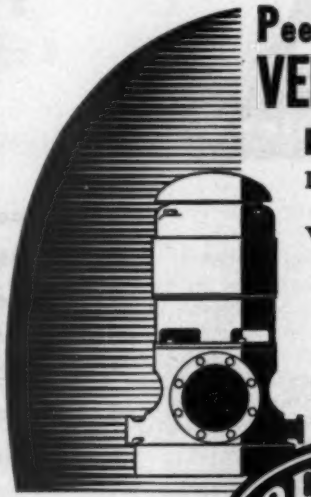
Chlorinating swimming pools, drinking water, waste
Fluoridation of municipal water supplies
Corrosion and scale control, phosphate injection
Chemical waste treatment
Automatic sampling

Accurate, dependable, positive displacement, diaphragm type pumps. Constant rate or meter paced for automatically variable output.

PRECISION MACHINE COMPANY

8 Walnut Street **Somerville, Mass.**

Peerless VERTICAL PUMPS



Deep Well and Close Coupled Pumps for Water Supply, Cooling Tower Service, Flood Control, Drainage, Sewage Disposal and Process Services.

Write for descriptive Bulletin on type you require.

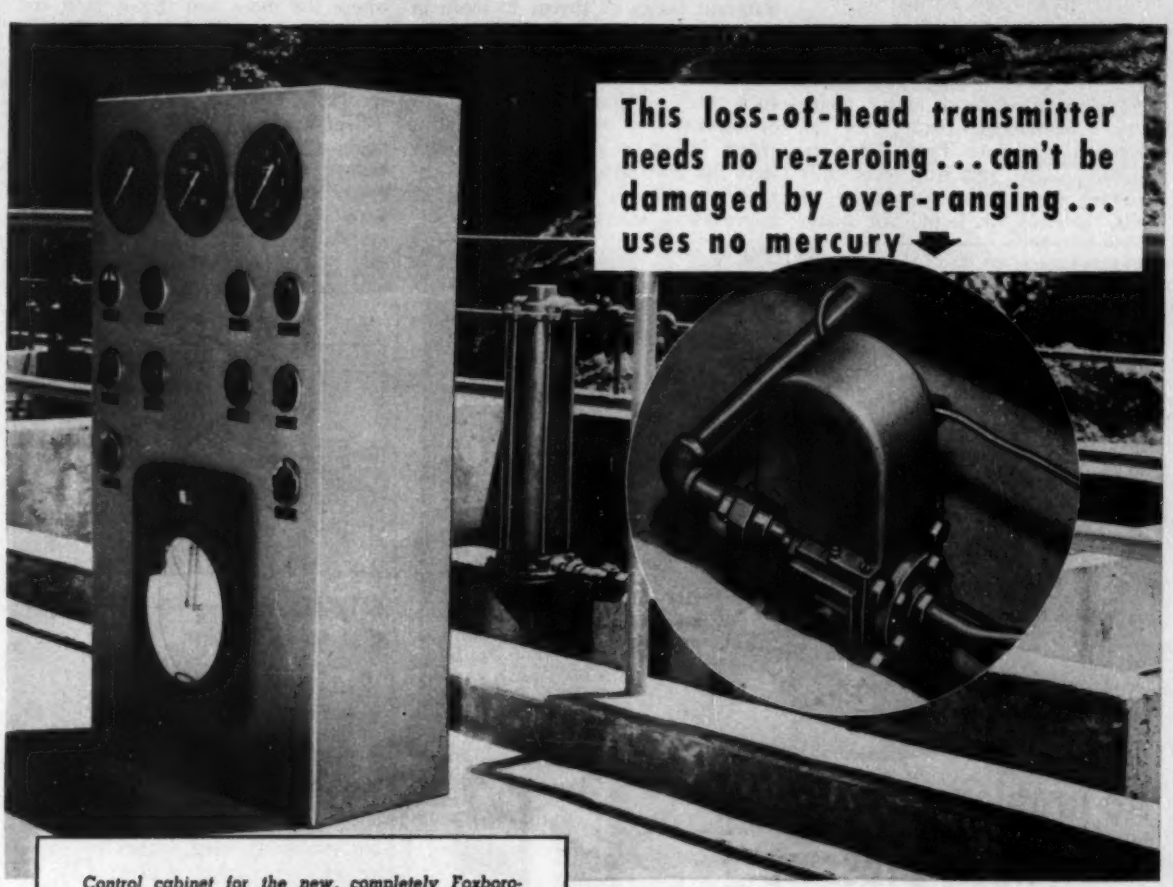
PEERLESS PUMPS

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corp.

Factories: Los Angeles, Cal.; Indianapolis, Ind.
Offices: New York; Chicago; St. Louis; Atlanta; Phoenix; Dallas, Plainview and Lubbock, Tex.; Fresno; Los Angeles; Albuquerque; Tulsa

PEERLESS BUILDS DEPENDABLE PUMPS

SLICKEST WAY YOU EVER SAW TO SAVE MAINTENANCE TIME!



Control cabinet for the new, completely Foxboro-instrumented plant of the North Marin County Water District. Two outside gauges at top of panel indicate d/p Cell measurement of loss-of-head. "Easy, economical operation plus neatness" are outstanding advantages of d/p Cell Transmitters cited by plant. Other controls on panel are for effluent rate and backwash. Consulting engineers: Clyde C. Kennedy, San Francisco.

The new water treatment plant of the North Marin County Water District, Novato, Calif., is realizing substantial maintenance savings by using Foxboro d/p Cells to measure and transmit loss-of-head.

The d/p Cell* Transmitter is *designed* to give trouble-free performance. There's no pulley-and-cable arrangement to get out of calibration . . . no mercury system, sensitive to backwash and sand. It's a compact, weatherproof transmitter that detects loss-of-head pressure differential across its tough metal diaphragm . . . converts measurement to proportional pneumatic signal for the indicating receiver. And it's available to measure from 25" to 800" of water in widely adjustable ranges.

Find out how this rugged, reliable transmitter can save time and money in your plant. Write for detailed information on the Foxboro d/p Cell.

*Trademark

THE FOXBORO COMPANY, 892 NEPONSET AVE., FOXBORO, MASS., U. S. A.

FOXBORO REG. U. S. PAT. OFF. d/p cells

FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND

(Continued from page 96A)

Moore will be responsible for the general sales activities of the company.

Mr. Moore is a graduate of Washington & Jefferson College and is a resident of Rosslyn Farms.

Miniature Venturi Tube

202

Simplex Valve and Meter Company, Philadelphia, Penn., has developed a miniature Type TF Venturi tube. This unit was specifically designed for the measurement of fluids, gaseous or liquid, in quantities considered too small for the application of a normal size Venturi or orifice.

This type of tube may be furnished with sizes of inlet of ½", ¾", 1", 1¼", 1½" and 2", there being four different ratios of throat to main in each of these sizes. Ordinarily, the Type TF Venturi is intended for installation directly in the pipe line. In such cases, no supplemental approach or downstream pipe section is provided. When the pipe line is of other than the selected standard ratio Venturi, attention to the conditions of approach is necessary.

Component parts of the tube are welded together to form a completely integrated assembly, each part having been machined to a tolerance of 0.0005". It is furnished with annular pressure equalizing rings at the point where the main and throat taps are located and usually is equipped with flanged ends. Screwed ends for sleeve couplings may be provided if specified.

Simplex's TF Venturi may be made of cast iron, stainless steel, or bronze, to suit the fluid to be measured. Secondary instruments, for use with these primary devices include manometers, as well as inferential meters of the indicating, recording and totalizing type.

no problem with water pressure in Newark!

Since 1934, by using cement lining in its trunk mains, Newark's water flow has been boosted from 57 to 83 million gallons a day.

This was made possible by converting old pipes into new—free of tuberculation and interior corrosion. Here's how it was done: old pipes were hydraulically cleaned, centrifugally machine-lined with mortar cement and smoothed to an even surface. The result: distribution pressure and carrying capacity greatly increased, maintenance costs substantially lowered and life expectancy of pipes extended indefinitely. Entire process done with pipes in place at a *fraction* of the cost of laying new pipes.

CENTRILINE CORPORATION

A subsidiary of Raymond Concrete Pile Co.

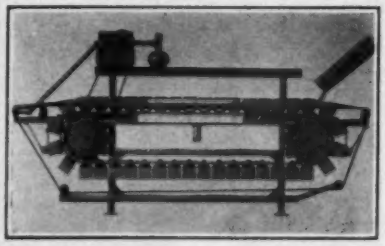
140 CEDAR STREET, NEW YORK 6, N. Y.

Branch offices in Principal Cities of United States and Latin America

3,000,000 FEET OF EXPERIENCE

Write today for booklet!

CEMENT-MORTAR LINING OF PIPES IN PLACE



New Dewatering Filter of Radical Design

203

Hardinge Company, Inc., York, Pa., announces the "Tray Belt Filter"—a completely new type of continuous, liquid-solids separating device, which can be used: (1) for relatively fast filtering materials; (2) for washing grains or salts, either by direct or counter-current action; (3) for filtering solids not readily maintained in a fluid suspension prior to filtering, such as coarse sand or materials devoid of supporting slimes.

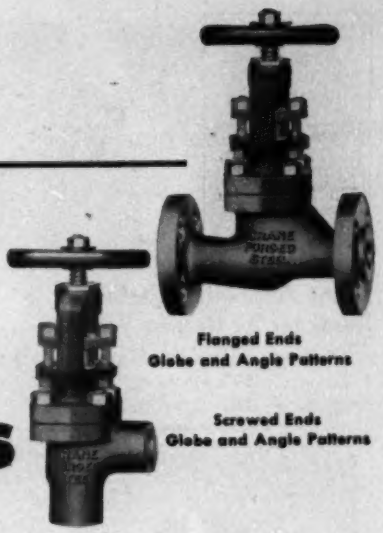
A simple, sturdy and inexpensive mechanism, the unit consists of a series of connected, traveling, perforated trays in sliding contact with a suction box beneath and supporting a filter cloth which moves with, but is not attached to the trays. The raw liquid-solids mixture is fed by gravity onto one end of this conveyor-like structure. The suction box rapidly removes the liquid from the feed, leaving a dewatered filter cake which drops from the filter at the discharge end at substantially the same elevation as at the feed end.

A washing action may be combined with filtration by use of water sprays above the filter cloth. A counter-current washing action can be obtained by means of a sectionalized suction box and reuse of the wash water from each section in successive sprays, approaching the feed end.

unmatched in dependability

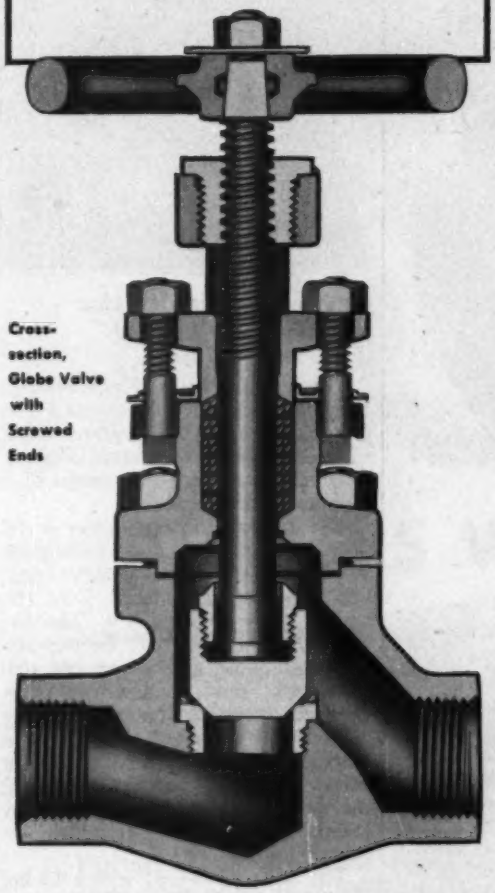
CRANE

chlorine valves



Flanged Ends
Globe and Angle Patterns

Screwed Ends
Globe and Angle Patterns



Cross-section, Globe Valve with Screwed Ends

now regularly available with screwed ends *and* flanged ends

Take your choice of patterns in these Crane chlorine valves. They're *Crane Quality* throughout—designed exclusively for water-free chlorine gas or liquid up to 300° F.

In the cross-section you can see their strong, rugged construction—and the narrow bearing 45° taper disc and seat design that provides positive closure. Corrosion-resistant materials are used at all critical points. Disc, body seat ring and disc stem ring are durable Hastelloy "C." The stem and the gasket at the leak-proof bonnet joint are Monel. In the extra deep stuffing box there's laminated packing specially developed for chlorine service.

You're better equipped for chlorine control with Crane chlorine valves. Sizes ½ to 2-inch.

FULL FACTS are in new 4-page folder AD 1976. Write direct or ask your Crane Representative next time he calls.

THE BETTER QUALITY... BIGGER VALUE LINE... IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

Evans Appointed Eastern Manager by Darling Valve

Darling Valve & Manufacturing Company, Williamsport, Penna., has announced the appointment of M. Stuart Evans as Eastern Regional Sales Manager.

Mr. Evans joined Darling Valve as District Representative in Tulsa, Oklahoma in 1950. He served in United States Army Ordnance in the last war. He attended the University of Kansas at Lawrence, Kansas.

Dorr Company Elects Five Vice Presidents

Dorr Company, Stamford, Connecticut, has announced the promotion to the vice president level, five senior department heads.

These new officers are: Frank H. Conover, Manager of the Procurement and Production Dept.: Harold B. Coulter, head of the Mechanical Engineering Department: John D. Crothe, Manager of the Consulting Engineering Dept., who was also elected a director: Dougles C. Reybold, controller and director: and Dr. Elliott J. Roberts, the company's Technical Director in Charge of Research, Development and the Westport Mill.

MH
DOUBLE SQUARE BOTTOM
GATE VALVES
When it is desired to install a gate valve for throttling purposes, or in a vertical pipe line, M & H double square bottom valves have many important advantages.
When valve is opened, each of the three shoes on both discs immediately contact the feathered edge of the tracks. These three contacts result in the disc being eased away instantly from the seat. The shoes then ride the tracks squarely and firmly for the full travel of the disc. In closing, discs ride the tracks down to a point exactly opposite the valve seat. At that point, the discs are clear and free to seat by action of the two spreaders, each functioning independently of the other. The tracks are stainless steel channels and the two side shoes are bronze-faced.
M & H double square bottom valve prevents the down stream gate from tilting into the down stream port opening and by chatter or vibration damaging the seat and gate rings. These valves can be installed with either disc on the down stream side.
Available in classes A, B, and C, sizes 3" and larger. Where needed, can be supplied with rollers; or rollers and scrapers. For complete information, write or wire M & H Valve and Fittings Company, Anniston, Alabama.
M&H PRODUCTS
FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION

New Sludge Disintegrator Can Be Power Loaded

204

Royer Foundry & Machine Co., Kingston, Penn., has developed a new portable Sludge Disintegrator with sufficient capacity to operate efficiently when power loaded by means of a front end tractor bucket.

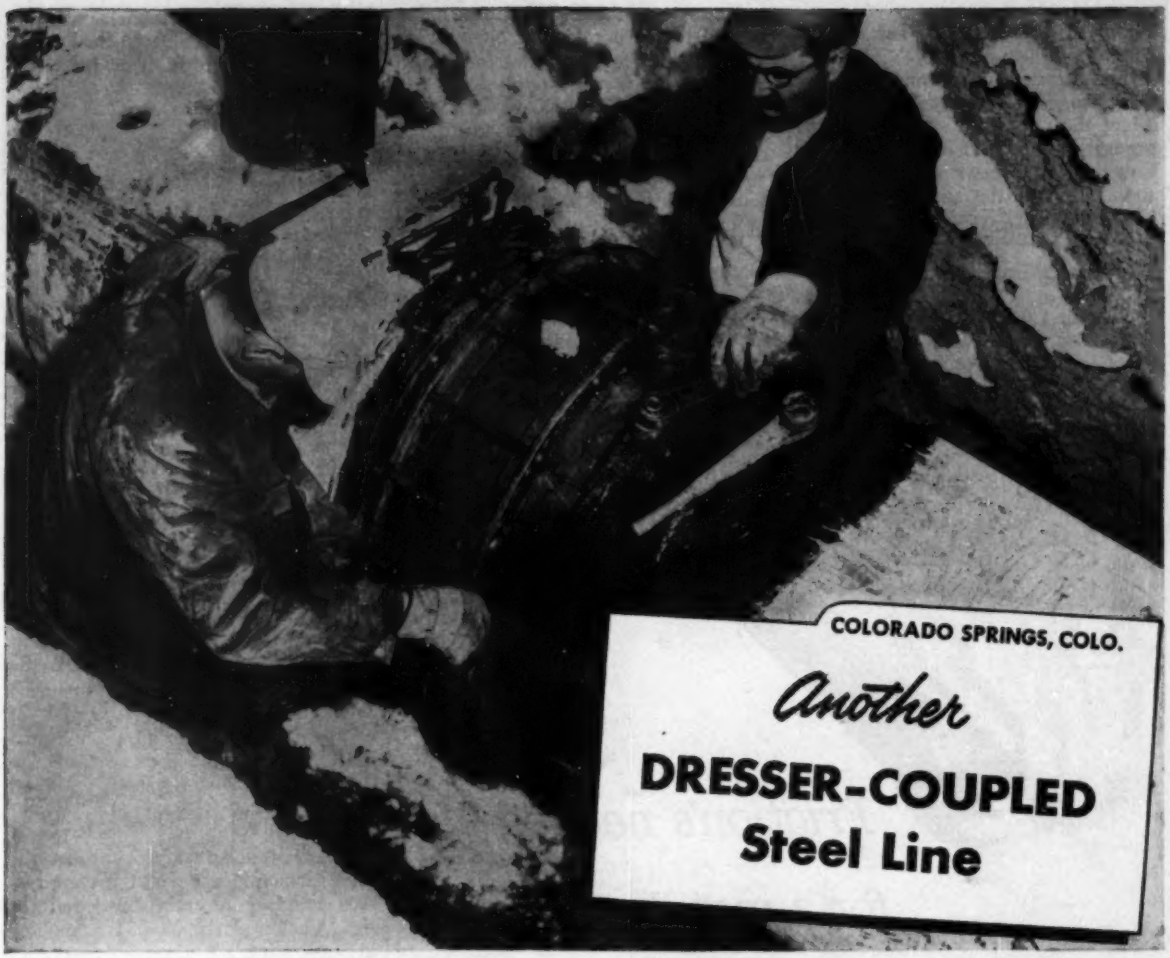
The large receiving hopper is 60 inches wide and contains a baffle plate and adjustable control gate to regulate the flow of material from the hopper to the combing belt. The disintegrator will shred decomposed leaves, compost, and manure, as well as topsoil, sand, sludge and other similar materials. Its capacity may be generally described as sufficient to process the contents of a 12 cubic foot tractor bucket in 15 seconds, provided the material is of such consistency that it is free to flow through the receiving hopper.

The unit is powered with a 15 hp, totally enclosed, electric motor, and has a combing belt 3 feet wide, and 9 feet in circumference. A machine of similar capacity is also available with a gasoline engine drive.

Pitometer Company Changes Name

The Pitometer Company, Inc., New York, N.Y., has announced that its name has been changed to The

(*Continued on page* 102A)



DELIVERS WATER CHEAPER!

Colorado Springs installs high-pressure, 30-inch line in rugged mountain terrain with minimum of heavy equipment.

High-pressure steel pipe—50,000-lb. yield—was used in this line carrying water from the South Platte River to Catamount Reservoir near Divide, Colorado.

Portions of this force main were designed to operate at pressures up to 800-lb. psi. A Dresser-Coupled steel line offered engineers positive assurance of permanently tight joints.

Fast construction schedules were made and *kept* because Dresser Couplings went together quickly and easily regardless of weather or trench conditions. Laying costs were reduced by the ability of small crews to handle and join lighter weight steel pipe with a minimum of skill and heavy equipment. The absence of heat in joining prevents damage to the coal tar enamel pipe coating and lining. Glass-smooth linings assure sustained high flow-coefficients.

The result—another line that delivers, and will keep delivering water cheaper.

✓ ***BE SURE*** **you get the *best* line at the *best* price. Always put steel pipe and Dresser Couplings in *your* specifications.**

DRESSER COUPLINGS

Dresser Manufacturing Division, 69 Fisher Ave., Bradford, Pa. (One of the Dresser Industries). Warehouses: 1121 Rothwell St., Houston, Texas; 101 S. Bayshore Highway, South San Francisco, California. Sales Offices: New York, Philadelphia, Chicago, Houston, South San Francisco. In Canada: Toronto, Ont.

(*Continued from page* 100A)

Pitometer Associates, Inc., Engineers.

The company also announced that the change in name will in no way affect the corporate structure of the organization and business will be continued as before with the same personnel and at the same address, 50 Church Street, New York City.

Waterproofing Paint

205

Monroe Company, Inc., Cleveland, Ohio, has developed a new oil base paint for waterproofing masonry surfaces.

Known as DAMP-SEAL, the paint is said to resist moisture on interior and exterior masonry surfaces for years, with just one application. It contains a grit-like volcanic ash filler which fills up small pores and stops capillary action. According to the company, Damp-Seal waterproofs without peeling, chipping, blistering or cracking.

Available in seven attractive colors, Damp-Seal requires no sizing and can be applied over unpainted or previously painted surfaces, wet or dry. It is said to be equally effective on interior or exterior surfaces, above or below grade, and can be used as a sealer and filler for high gloss enamels. According to the company, Damp-Seal colors will not chalk off, stain or fade.

New Plastic Clamp For Use With Insert Fittings

206

The Carlon Products Corporation, Cleveland, Ohio, has announced the development and production of a unique molded plastic clamp which is utilized to effect a tight, permanent seal when sections of flexible plastic pipe are connected by means of insert couplings, tees, ells and adapters. It is slipped over the pipe ends and tightened to force them down onto the serrations incorporated in insert fittings to create a positively leakproof connection.

The new clamp incorporates the same principle used in the compression coupling recently developed for rigid Carlon plastic pipe. It is molded in two separate threaded sections. Butted against a shoulder at the base of the female threads in one half is a synthetic gasket with a V-shaped groove. When the other half of the clamp is screwed down onto this gasket it is forced against the pipe. Consequently a full 360° pressure is exerted on the pipe to make it grip the insert fittings tightly. Connections made in this way are literally stronger than the pipe itself.

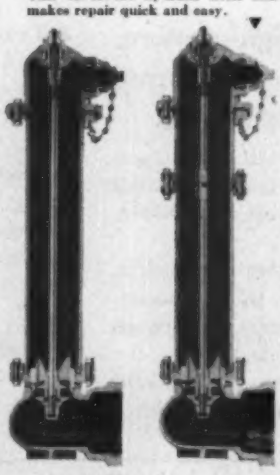
This new clamp makes possible the installation of completely plastic pipe lines. Prior to its development, a steel clamp was used for insert connections. Like all Carlon pipe, this plastic clamp is impervious to rot, rust and electrolytic corrosion and can be used in most adverse conditions. When the unit is positioned, the specially compounded gasket is completely enclosed by plastic and therefore protected from fluids, ozone and other deteriorating forces.

The Carlon clamp is produced in sizes for ½, 1,, 1½, 2, 3, 4 and 6-inch plastic pipe. It is tightened easily by means of a strap wrench and can be removed and reused when pipe installations are changed.

Friction's needed for a match but it's no help in a fire hydrant

Friction causes loss of water pressure and reduces the effectiveness of fire-fighting equipment. That's why R. D. Wood Hydrants are designed to cut friction way down—and why so many communities rely on them for fire protection.

The R. D. Wood Hydrant can be furnished with breakable flange and stem coupling at extra cost. Both are built to break with a heavy blow. This saves the hydrant itself and makes repair quick and easy.



THE R. D. WOOD SWIVEL JOINT HYDRANT: All internal parts, including drain valve seat, removable through barrel • all-bronze stuffing box • completely revolving head • compression-type valve, cone shaped to prevent water hammer • automatic drain valve • bronze main valve seat screws directly into elbow with straight, not tapered threads • mechanical-joint pipe connections if specified

R. D. Wood Swivel Joint Hydrants

Public Ledger Building, Philadelphia, Pa. | Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

ACT NOW!

rehabilitate your water system and give it new life with . . .

IOWA

MECHANICAL JOINT CUTTING-IN VALVES AND SLEEVES

Replace those "tired," worn-out valves . . . be prepared for all emergencies!

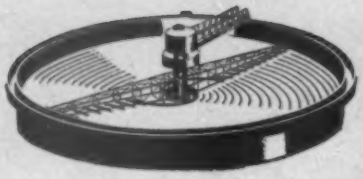
Now, more than ever, it's vital to keep your customers supplied with water and fire protection at all times . . . Replace worn-out valves and add needed valves with IOWA Mechanical Joint Cutting-In Valves and Sleeves . . . It's the fastest, simplest and most economical method of cutting gate valves into existing water lines . . . Furnished complete with joint accessories . . . No lead, no jute, no caulking . . . Just a ratchet wrench . . . Ideal as auxiliary valves for fire hydrants . . . Simplifies hydrant inspection and maintenance . . . Act now before it's too late . . . Write today for descriptive literature!

KEEP WORK CREWS BUSY ON JOBS LIKE THIS . . . IT PAYS!

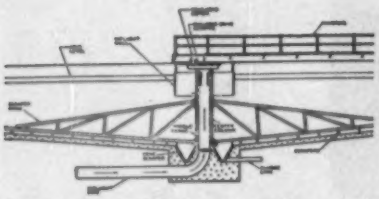
IOWA VALVE COMPANY

201-299 N. Talman Ave., Chicago 80, Ill. • *A Subsidiary of James B. Clow & Sons*

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.



Center-Feed Center-Discharge Clarifiers



One reason for the efficiency of Hardinge Clarifiers is the fact that the influent goes directly to a central stilling well and the underflow also is centrally removed. This promotes quick disposal of the heavier solids immediately upon entry—makes less work for the rotating sludge scrapers. The clear effluent overflows the tank periphery, where velocity is at a minimum. Bulletin 35-C-15

HARDINGE
COMPANY, INCORPORATED
YORK, PENNSYLVANIA · 240 Arch St. · Main Office and Works
New York · Toronto · Chicago · Hibbing · Houston · Salt Lake City · San Francisco

J. L. North

R. Vannelli

Marlow Pump Appoints Assistant to Sales Manager and District Engineer

Marlow Pumps, Ridgewood, New Jersey has announced the appointments of John L. North as assistant to the sales manager, and Roger Vannelli as District Engineer.

Mr. North, prior to his association with Marlow, worked in an engineering capacity for Hinds and Dauch Paper Company. North served with the Navy in World War II and later graduated from Fordham University with a B.S. degree.

Mr. Vannelli, as District Engineer, will serve the three state area of Virginia, West Virginia, and North Carolina. He will make his headquarters in Raleigh, North Carolina. He joined the Marlow organization in 1951, and after completing the training course, became an office sales engineer. He later handled the New England territory for the company. Prior to his Marlow association, Vannelli was a pump application engineer, and later associate pump supervisor at the Bayonne, N.J., refinery of Standard Oil Co.

Rid-X Destroys Waste in Septic Tanks, Cesspools, Outhouses

207

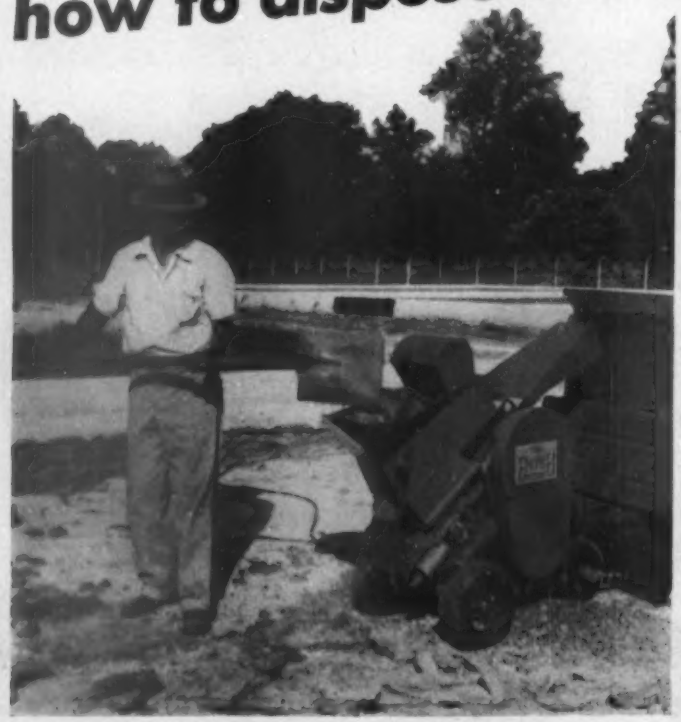
The d-Con Company, Chicago, Ill., has announced plans for the retail distribution of Rid-X, a new highly-concentrated powder designed to liquefy and destroy waste matter in septic tanks, cesspools, and outdoor units more than twice as fast as ordinary action. Rid-X also contains two potent deodorizing agents, including chlorophyll, which help eliminate odors.

Rid-X will be available in convenient one-pound packages sufficient for a 1000 gallon unit, and is priced at $1.69.

According to the company, the use of Rid-X—which is poured directly into drain, toilet, tank or pit—has been found effective not only in destroying

(*Continued on page* 106A)

how to dispose of sewage sludge *Profitably!*



Sewage sludge disposal can be a cost or a profit item. Instead of paying to have it burned, buried or hauled away, why not process it with a Royer Sludge Disintegrator into a ready-to-use fertilizer?

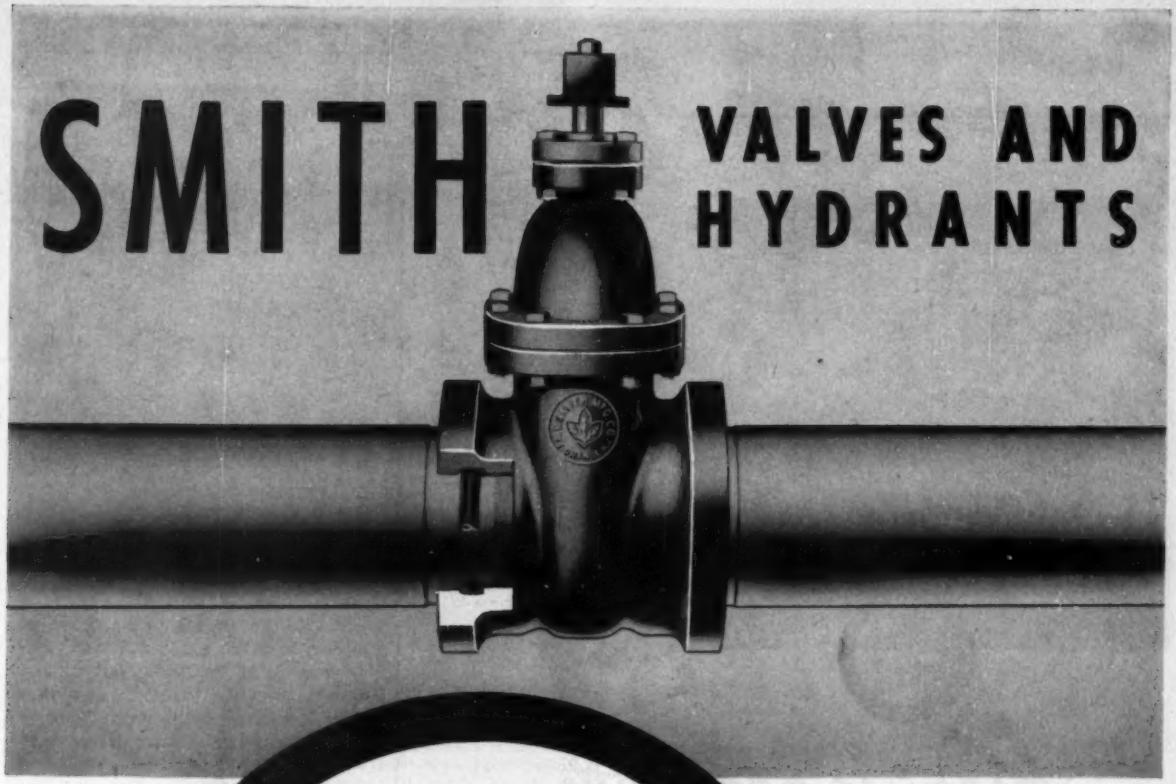
Sludge cake with moisture content as high as 56% can be shovelled directly into the Royer where it is completely shredded, pulverized, aerated and discharged to pile or truck, with all trash removed. Additional fertilizing ingredients may be added if desired.

Florists and nurserymen, gardeners, golf clubs and parks furnish a ready market for this valuable, nitrogen rich product. Sewage plants all over the country are finding the Royer method of sludge disposal a profitable one.

Write for further information on sizes and models available.

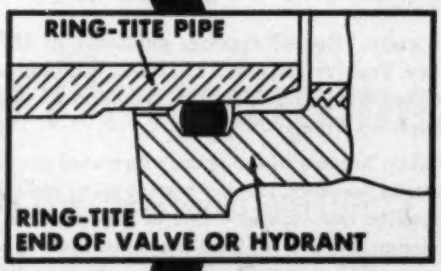
ROYER FOUNDRY & MACHINE CO
170 PRINGLE ST., KINGSTON, PA.

SMITH VALVES AND HYDRANTS



WITH

NEW RING-TITE JOINT.....



Smith A. W. W A. Specifications Gate Valves (4" through 12") and Smith Fire Hydrants (with 4" or 6" connections) are now available with Ring-Tite joints for direct connection to Johns-Manville Class 150 Transite Ring-Tite Pipe. No special fittings or extra joint material needed. Installation is quick, easy, economical, and joints can be made in any weather and in roughest terrain. Tight, flexible joints are assured. At low pressures, radial compression of rubber ring seals the joint; increasing pressure wedges the rings—the higher the pressure the tighter the seal. For complete details write for Bulletin RT 53.

49

FIRE HYDRANTS · VALVES · SINCE 1896

THE A.P. SMITH MFG. CO.

EAST ORANGE. NEW JERSEY

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Keeping pace with industry for 100 years

This early "Roots" catalog, published in 1879, offered only Rotary Positive Blowers. That was our exclusive business at that time—25 years after the invention of the rotary positive principle by Francis M. Roots.

Today, because of the greatly increased use of gas and air for industrial purposes, it takes a great many bulletins and booklets to describe our expanded line of products. As new ideas, new developments are utilized in industrial processing, Roots-Connersville keeps pace with new equipment to handle gas and air most effectively and economically. And that is still our only business.

Into these bulletins, any of which are yours for the asking, are condensed our 100 years of experience in building such equipment, from the first Rotary Positive Blower in 1854 to our latest 1953 development, the Spiraxial Compressor. They describe R-C products which are up to date in design and construction, to match specific needs of industry.

We suggest that when your business has a job of handling gas or air, you consult the exclusive specialist for 100 years.

Reg. U.S. Pat. Off.

BLOWER BUILDERS SINCE 1854

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.
254 Mount Ave. • Connersville, Indiana

(*Continued from page* 104A)

dangerous human waste, but also in dissolving fats, oils, grease and papers, and unclogging pipes, thus keeping disposal units in smooth working order. Rid-X is harmless to humans, animals, metal, porcelain and plumbing installations.

New Handle for Model 400 Rolatape

208

Rolatape Inc., Santa Monica, California, manufacturers of wheel type measuring instruments, have designed a new type extension handle for their Model 400 for operating out of any standard moving vehicle. The new handle has greater rigidity and longer length which gives greater driver comfort and ease of operation.

The Model 400 is designed for longer distant measuring and is ideal for preliminary surveys, field inventories, geophysical and geological work as well as roads and cross-country measurements. Rolatape Model 400 is one-man operated and can register over 18 miles. Rolatape is offering a 10 day Free Trial on any model.

Marlow Names Hinnes Service Manager

Marlow Pumps, Ridgewood, New Jersey has announced the appointment of Mr. Harold Hinnes as manager of the company's newly created service department. Reorganization of service facilities into a separate department will concentrate added attention on this important phase of the company's business. The new department will act directly for dealers and customers to provide prompt and specialized attention to all requests for parts, repairs, and service information.

View of four bodies of 54" ROTOVALVES with two plugs in the background. These valves are part of a large order under construction for the City of New York, Board of Water Supply, Delaware Aqueduct Project.

A Very Real Contribution to Water Works Development!

The ROTOVALVE answers the ever increasing need in the waterworks field for a valve which couples ease of operation with positive performance under both normal and emergency conditions. For these reasons it was selected for both shut-off and throttling services on this important project.

S. MORGAN SMITH Co.

YORK, PENNA. U.S.A.

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

THOROSEAL *Restored* this Filtration Plant

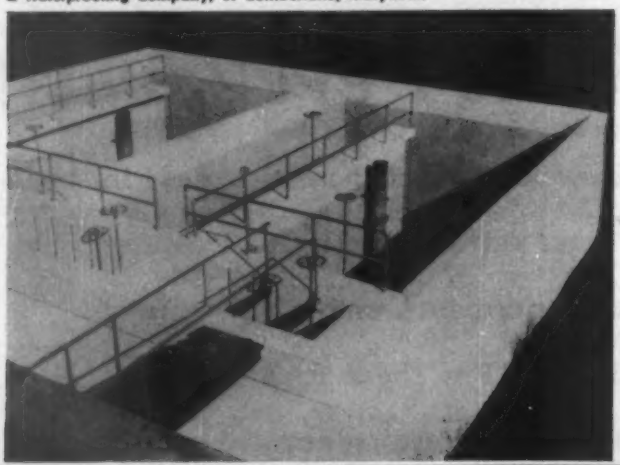
BEFORE

Example of complete break-down of masonry, due to penetration of water into body of concrete and action of frost in damp masonry.

It is amazing how THORO System products will correct a condition, such as shown in photograph. Concrete was sandblasted to remove all disintegrated material to sound concrete surface and reinforcing rods. Patching was done with THORITE Patching Mortar, bringing blistered areas to true and even lines, followed by two applications of WHITE THOROSEAL for protection.

AFTER

At minimum cost, almost ½ the cost of other methods, concrete restoration, patching and surface protection was completed with THORO System products on Filtration Plant in Keyser, West Virginia. Contractor: Standard Construction & Waterproofing Company, of Cumberland, Maryland.

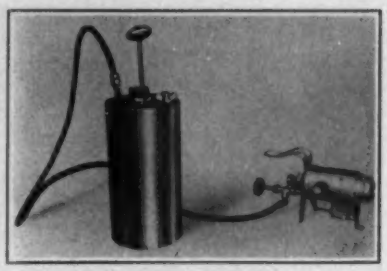


WATERPLUG	THOROSEAL	QUICKSEAL
To Stop Leaks	To Seal Surface	For Beautiful Finish

Our 20-page Brochure describes, in detail, how The THORO System products can benefit you in your construction plan. Send for brochure today, which shows methods of application and how to use the material.

Standard Dry Wall Products

Box X, NEW EAGLE, PENNA.



"Super-Jet" Blow Torch

209

Perfection Stove Company, Cleveland, Ohio, has announced a "Super-Jet" Blow Torch which operates efficiently at all temperatures, even as low as 70° below zero.

This Model E75 Blow Torch preheats its own combustion air, enabling it to be started in extremely low temperatures at which standard torches cannot be successfully operated.

By having a separate fuel tank supplying fuel to the torch under low pressure (45 p.s.i.) the Perfection Blow Torch eliminates the hazard of fire, allows for the use of any size tank and any length of all-metal hose. The cylindrical fuel tank supplied is of half-gallon capacity and will operate the blow torch for 50 minutes on one filling. It weighs only 6½ pounds, has its own supporting stand, a manual air pump and pressure gage.

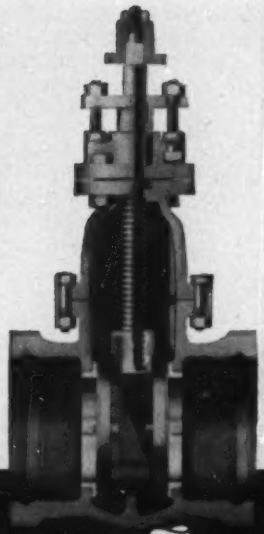
Perfection's fuel-jet clean-out plunger clears the jet while the torch is operating, without danger of fire during the clean-out action. This 75,000 B.t.u. per hour torch is built of stainless steel throughout. The fuel-metering needle valve is made of heat-resistant stainless steel for long life and extreme accuracy in fuel control.

This multi-use blow torch will supply plenty of heat to warm up air-cooled engines on generators, portable pumps, winches, tractors and cement trucks. It may be used to remove paint and strip machinery; to thaw out water pipes and tanks; to heat several soldering irons simultaneously; and to supply personnel heat when used with a secondary heat exchanger.

Hammond Iron Works Opens Birmingham Plant

Hammond Iron Works, Warren, Penna., has just announced the completion of a modern fabricating plant on the outskirts of Birmingham, Alabama. Located on 23 acres of former cotton fields, adjacent to rail and highway facilities, this plant is fully

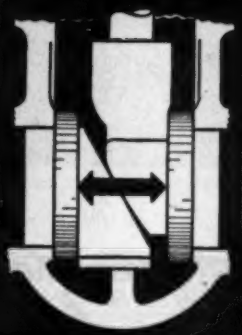
(*Continued on page* 110A)



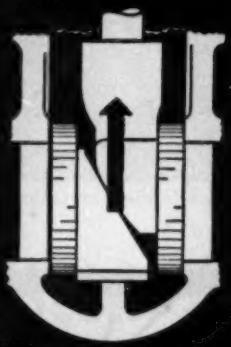
Look how you gain LONGER, TROUBLE-FREE VALVE LIFE

with Darling revolving disc gate valves*

DESCENDING. Fully revolving discs, independently hung, change seating position at each closing, assuring uniform wear distribution for prolonged service. Plain "no pocket" discs are interchangeable for *extra* life!



CLOSED. Faces of upper wedge are radiused and faces of both wedges are transversely beveled for equalized wedging pressure and *tight closing despite valve body distortion.*



RISING. Wedging pressure on both discs is released before discs start to rise. Complete absence of wedging pressure during travel of discs assures easy operation, tight closing and greatly prolonged valve life!

***DARLING REVOLVING DISC GATE VALVES FOR EVERY NEED.**

These unique Darling valves are available in a broad range of sizes and types, manually or motor operated, for all normal or unusual services. Before you invest in *any* valves, find out what you stand to gain by using the proper Darling valves on your job. Simply outline your service needs for specific data . . . or . . .

ASK FOR BULLETIN No. 5002

DARLING VALVE & MANUFACTURING CO.

Williamsport 11, Pa.

Manufactured in Canada by The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ontario

FOR PLUS VALUES, JOB-PROVED AGAIN AND AGAIN

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

BOARD OF PUBLIC AFFAIRS
MILLERSBURG, OHIO

June 24, 1953

Simplex Valve & Meter Co.
Philadelphia 42, Pa.

Gentlemen:

We have acquired a Simplex Venturi main line meter from the City of Wooster, Ohio. This meter was sold to City of Wooster on May 4, 1912.

We plan to install this meter on our main line at Millersburg, Ohio Water Plant. Will you please send me descriptive information and parts list for this meter.

Markings on identification plate are as follows:
8" Tube 4" Throat #8-43-548-G.D. MSD 38.187
May 4, 1912 Markings on Cover Plate #546

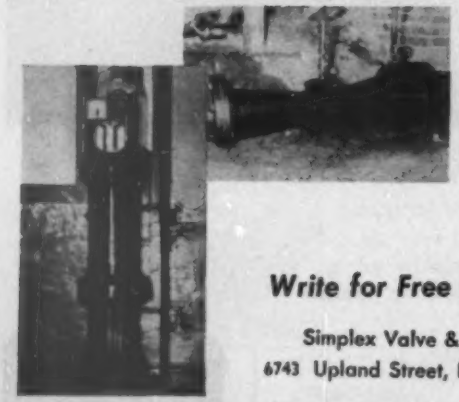
Address reply to: C. R. Deitrich, Supt. of W.W.

Respectfully,

C. R. Deitrich

C. R. Deitrich

Another proof that Simplex is reliable in the long run!



Simplex Meter and Venturi Tube recently installed after service of over 40 years!

Write for Free Bulletin No. 500

Simplex Valve & Meter Company,
6743 Upland Street, Philadelphia 42, Penna.

SIMPLEX®
VALVE AND METER COMPANY

(Continued from page 108A)

equipped with the latest in metal forming and handling machinery, is designed to produce the full line of Hammond products for the oil industry of the southeast and central southwest states. These products include field erected storage tanks for the petro-chemical and processing industries, elevated water tanks and standpipes, and all general types of steel plate construction.

J. F. Fuller

J. H. Snellgrove

Hersey Appoints Fuller Branch Manager

Snellgrove Joins Sales Staff

Hersey Manufacturing Co., South Boston, Mass., has announced the appointment of Jack F. Fuller as Portland, Oregon Branch Manager to succeed the late Harlow T. Judson.

Mr. Fuller was born in Seattle in 1919 and received his education there. He served in the U. S. Army from 1944 to 1946, serving two years in the Pacific theatre.

He joined the Hersey Company in 1948 as a salesman for the company's water meters. Mr. Fuller is a member of the Northwest Section AWWA and is on the Membership Committee of that section.

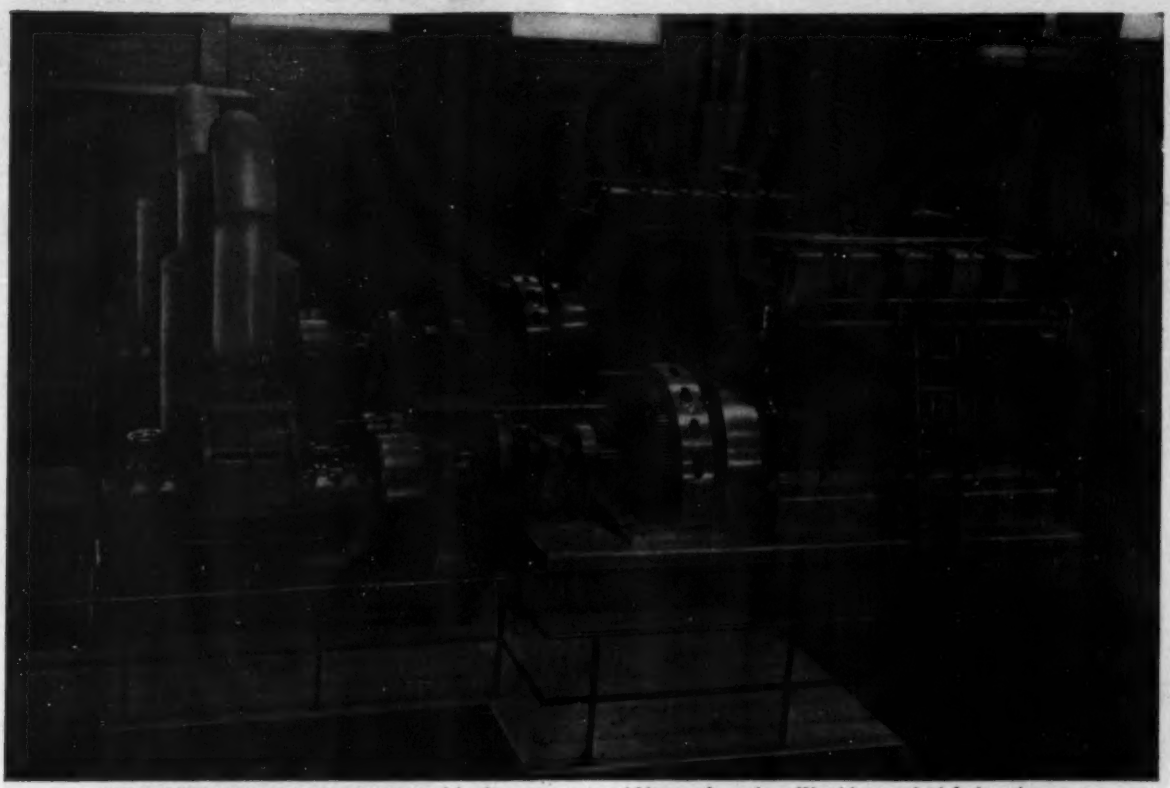
John H. Snellgrove, formerly Departmental Head and Purchasing agent for the Elgin Softener Corp., has joined the Sales Department of the Hersey Company, and is attached to the Los Angeles branch.

Mr. Snellgrove was born in and received his early education in Elgin, Ill., and attended the Elgin Institute of Technology in Chicago. He served four years in the U. S. Marine Corps, and now holds the rank of Major in the Marine Reserve.

Buchan and Wall Promoted By Electric Machinery

Electric Machinery Mfg. Company, Minneapolis, Minnesota, has announced the appointment of Mr. C. E. Buchan to the newly created position of General Sales Manager, Vice President in Charge of Sales. A veteran of thirty years with E-M,

(Continued on page 112A)



LITTLE FERRY STATION GETS POWER to drive its generators and blowers from these Worthington dual fuel engines.

Bergen County sewage system to serve 50 communities

System's power costs lowered by dual fuel engines using sewage gas

• The Little Ferry Treatment Plant was opened three years ago by the Bergen County Sewer Authority, and is now handling the raw sewage of ten communities. This plant is part of a system that will eventually serve about 50 New Jersey communities.

The Authority found that a large strategically-located plant equipped with dual fuel engines to generate the required power handles the entire job more efficiently and at a lower cost than a number of small plants.

Economical Worthington dual fuel engines used at the Little Ferry Station are designed to operate on either sewage gas or oil. They will maintain load in the event of a sudden emergency loss of gas supply by automatically switching to oil.

Get all the facts on Worthington dual fuel or gas engines. Write for complete information to Worthington Corporation, Engine Division, Section E.3.9, Buffalo, New York. E3.9

WORTHINGTON

Economical Continuous Power—Diesels, Oil and Dual Fuel, and Spark-Ignition Gas Engines, from 190 to 2100 bhp.

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

*To Reduce Maintenance and lower Operating Costs.....

SEWAGE TREATMENT PLANTS ARE *Specifying.....*

HOMESTEAD

Self-Seald Lubricated

PLUG VALVES

THEY GIVE LONGER SERVICE BECAUSE THEY

automatically adjust for wear!

HOMESTEAD Self-Seald LUBRICATED PLUG VALVES provide lower-cost-per-year fluid control than any other valves within their service range. Extra long, leakless service, less maintenance and lower operating costs are assured by the exclusive, *self-sealing*, wedge-acting, two piece plug that *automatically adjusts* to make up for wear as wear occurs, thus keeping the seating surfaces of the plug and valve body in constant contact to maintain a perfect, drop-tight seal. Add to this the extra advantage of a full lubricant seal around the ports and the top and bottom of the valve, and you have the reasons why HOMESTEADS' are noted for lower replacement and maintenance costs. Specify "HOMESTEADS" on your next valve job, or slip them in on your next replacement.

We can furnish them in semi-steel or cast-steel, 100% Port Area or Venturi, in sizes ½" to 14", for steam working pressures to 150 lbs., or air—water—gas to 200 lbs. *Also available in one piece plug design.*

Some "Self-Seald" Features

- Combines positive seating of tapered plug with operating ease of cylindrical plug.
- Leakproof triple head seal.
- Port area equal to 100% std. pipe area.
- All sealing surfaces protected from line fluids.
- Full threaded lubricant screw.
- Quarter turn opens or closes.
- Port position indicator.

MAIL COUPON TODAY for VALVE REFERENCE BOOK No. 39-5

For local distributor see Yellow Pages of your Telephone Book.

Please send me VALVE REFERENCE BOOK No. 39-5 and price list of Homestead Self-Seald Lubricated Plug Valves.

NAME_____ TITLE_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

HOMESTEAD VALVE MANUFACTURING COMPANY

P. O. BOX 42 CORAOPOLIS, PA.

(*Continued from page* 110A)

Mr. Buchan has been the Cleveland District Manager for the past twenty-five years. Long known as one of the country's outstanding Application Engineers on Large Alternating Current Motors, Mr. Buchan brings a wealth of experience background to his new assignment. He will be in direct charge of the activities of the Company's forty-nine domestic American offices, as well as foreign representatives.

His successor as Cleveland District Manager will be J. J. Wall, for the past four years a Sales Engineer in the New York District Office. A veteran of World War II, Mr. Wall has ten years of successful experience in the application of alternating current power machinery.

New Line of L-P Pots and Torches

210

Turner Brass Works, Sycamore, Ill., has developed a new and complete line of L-P (Liquefied Petroleum) Fire Pots and Torches.

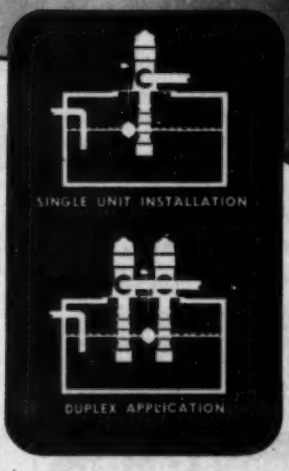
The fire pots are designed for double-duty service as either bench-type or tank-type units. Special features include heavy corrosion-resistant cast aluminum base, steel supporting posts, cast iron burner with wide flame range and high-speed melting efficiency, brass assembly parts, one-hand operation of flame control valve, one-piece steel hood, permanent windshield for all-weather use. Operation is at full tank pressure without requirement of regulator.

(*Continued on page* 114A)

For longer life—trouble-free service — higher sustained efficiency.

IT'S NEW

JOHNSTON
UNIT-LINE
SUMP PUMPS



Send for free copy of Bulletin K-24

JOHNSTON PUMP COMPANY, *Bin "K," Pasadena 19, California*

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

IT PAYS TO Specify

LEOPOLD

Glazed Tile

FILTER BOTTOMS

PERFORMANCE PROVED IN OVER 200 PLANTS WITH A DAILY CAPACITY OF MORE THAN 900 MILLION GALLONS!

With its many exclusive advantages, the Leopold Compound Duplex Filter Bottom provides the most practical and economical answer to your underdrain problems.

In this design, laterals and distributing blocks are combined in one permanent unit that insures uniform filtration over the entire filter bed and equal distribution of the wash water with minimum loss of head. The individual blocks—each about two square feet in area and weighing approximately 100 pounds—are made of highest quality de-aired fire clay, vitrified and salt glazed. They resist corrosion, are not subject to tuberculation, won't absorb any detrimental amount of water, and are impervious to acids and alkalis.

Adaptable to any rectangular filter unit, the efficient Leopold Filter Bottom needs only a shallow depth of small sized filter gravel to support the filtering medium. Further, the Leopold design does not require special supporting concrete members or the added concrete construction of a false bottom.

Complete Water Purification and Sewage Plant Equipment . . .

- DRY CHEMICAL FEEDERS
- FILTER OPERATING TABLES
- MIXING EQUIPMENT

Write today for details

F. B. Leopold Co., Inc.
2413 W. Carson Street
Pittsburgh 4, Pa.

(*Continued from page* 112A)

Tanks, with exclusive Turner construction features, are available in 20-lb. and 11-lb. sizes; have full-diameter, full-curled foot ring for greater stability and longer surface wear. I.C.C. approved.

The new Turner L-P Torch comes with three interchangeable all-brass burners—needle-point, medium, and large—to meet practically all job requirements. They do not require pressure regulators, are easy-lighting, have removable orifice blocks. Flame adjustment is by one-hand valve control.

Pipe Fitting Template

211

Graphic Indicator Company, Los Angeles, Calif., has developed a convenient time-saving drafting template for the engineer, designer and draftsman in all industrial and commercial drafting rooms. A pipe fitting indicator accurately made to scale for professional use; conforms to all pipe line graphic standards. Can be used for over 2,000 combined quick and accurate pipe fitting indications.

This drafting template indicates ⅛" to 12" I. D. pipe fittings in scales of ⅛", ¼" and ½". For detailing, gen-

(*Continued on page* 116A)

FOR MAKING SERVICE CONNECTIONS QUICKLY, EASILY!

SKINNER-SEAL SERVICE SADDLE

For steel, cast iron and Transite pipe. Single massive bolt. Sizes 1" to 12" inclusive. Write for catalog.

M. B. SKINNER COMPANY
SOUTH BEND 21, INDIANA

SINCE 1885

GRUENDLER

The Choice of Municipal Plants

32 units and 24 installations IN 1953

Orange County Sanitation Dist., Santa Ana, California
City of Newton, Iowa
Stege Sanitary Dist., Contra Costa County, California
City of Longview, Washington
TWA Hangar, Lambert Field, St. Louis, Missouri
Richmond-Sunset Sewage Treatment Plant, of San Francisco, California
City of Lewistown, Penna.
North Carolina Sanatorium, McCain, North Carolina
Newark State School, Newark, Wayne County, New Jersey
City of Valparaiso, Indiana
Williamsport Sewage Plant, Williamsport, Penna.
City of Spencer, North Carolina
City of Atlanta, Georgia
Gerber Products Company, Rochester, New York
City of Gladwin, Michigan
City of Conshohocken, Penna.
City of Salem, Mass.
City of Beaumont, Texas
Frankford Plant, Philadelphia, Penna.
Manchester 8th School & Utilities Dist., Manchester, Conn.
Grand Rapids Sewage Plant, Grand Rapids, Michigan
City of Fall River, Mass.
Sewage Treatment Plant, District of Columbia
Middletown Homeopathic Hospital, Middletown, Orange County, N. Y.
City of Rittman, Ohio

Gruendler Sewage Screening Shredder in connection with two Link-Belt Bar Screens, San Francisco, Calif.

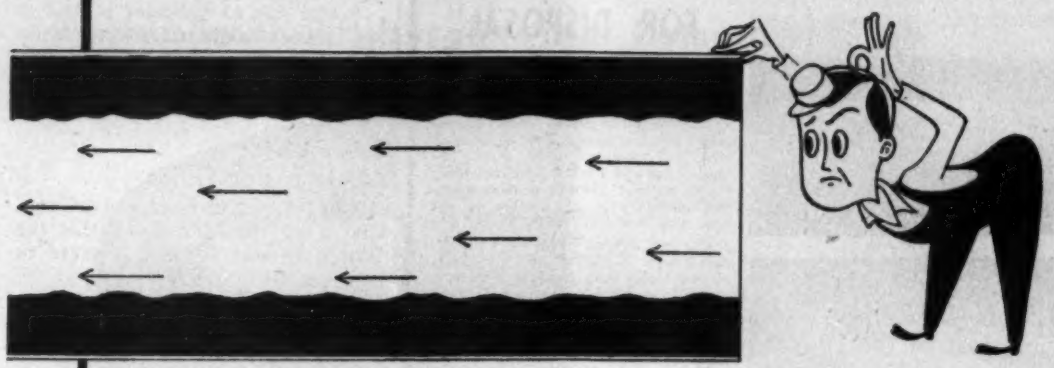
GRUENDLER
SEWAGE-GARBAGE SHREDDERS

Disintegrate wastes, including rag stock, for continuous flow!

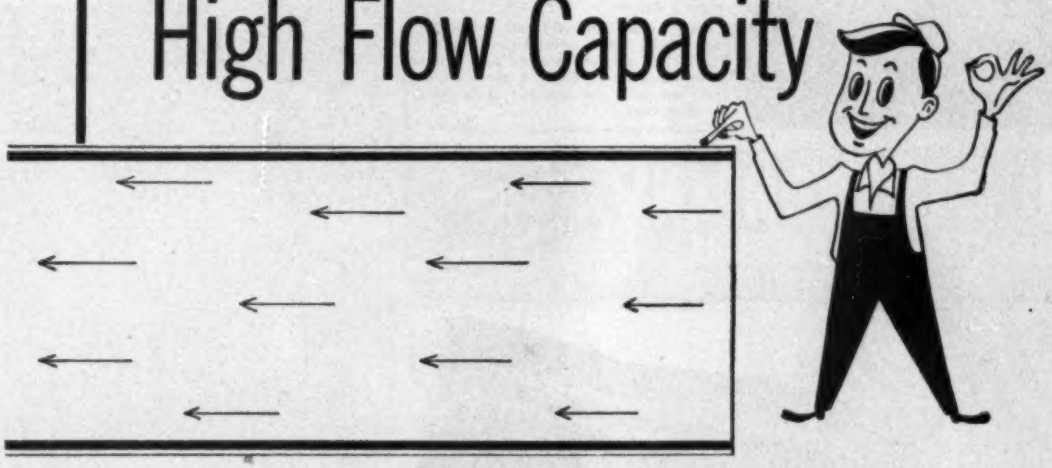
Bulletin S.G.10, mailed on request.

GRUENDLER
Crusher & Pulverizer Co.
2915 N. Market St., St. Louis 6
MISSOURI

LOW FLOW CAPACITY



High Flow Capacity



...Bitumastic 70-B Enamel makes the difference by preventing corrosion

Flow capacity *stays* high when Bitumastic® 70-B Enamel protects interior surfaces of steel pipe lines. This durable enamel prevents rust, corrosion, incrustation and tuberculation . . . keeps pipe lines from "shrinking." With this kind of protection, there's no need to spend money on *over-sized* pipe in order to allow for future loss in flow capacity. Flow tests conducted on steel pipe lines, centrifugally lined with hot Bitumastic 70-B Enamel, have shown the value of Hazen-Williams coefficient "C"=145 to 160.

You can save money in another way with Bitumastic 70-B Enamel. When applied to a thickness of 3/32", it protects the exterior of pipe against the corrosive action of the soil. It is wasteful to specify an excess of wall thickness to compensate for corrosion. It is more economical to specify just enough wall thickness to give the pipe adequate structural strength and to use Bitumastic 70-B Enamel to prevent corrosion.

Use strong, durable steel pipe, lined and coated with Bitumastic 70-B Enamel, and give your community worth-while savings. Write for full information on protecting large-diameter water lines.

BITUMASTIC 100TH Anniversary PROTECTION 1854 1954

KOPPERS BITUMASTIC® ENAMELS

KOPPERS COMPANY, INC., Tar Products Division, Dept. 361-T, Pittsburgh 19, Pennsylvania

DISTRICT OFFICES: BOSTON, CHICAGO, LOS ANGELES, NEW YORK, PITTSBURGH, AND WOODWARD, ALA.

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

CEMENT GUN CO. USES "GUNITE" FOR DISPOSAL PLANT REPAIRS

The top photo shows badly disintegrated concrete Imhoff Tank of a small New Jersey Sewage Disposal Plant. The repairs involved removal and rebuilding of two walls of this tank in their entirety, together with the relining of the tank with two inch "GUNITE".

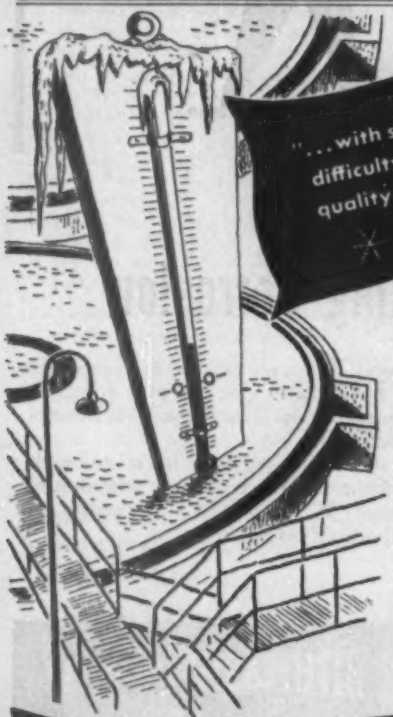
The two trickling filters were also repaired with "GUNITE" to a thickness of two inches both inside and outside, as well as rebuilding sections of the circular wall. On the interior of the trickling filters the "GUNITE" was carried down eighteen inches below rock line.

The repairs illustrated above have restored the Plant at small expense to original design.

Many varied types of repair, remodeling and new construction with "GUNITE" are described and illustrated in our Bulletin C 2400. A request on your letterhead will bring a free copy by return mail.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES – ALLENTOWN, PA., U. S. A.

MANUFACTURERS OF THE CEMENT GUN



"... with silica sol we encountered no difficulty in maintaining high water quality regardless of temperature."
CHEMICAL ENGINEER

Flocs resulting from N-Sol Activated Silica used with alum are fast forming, clear *settling* and tough. You need this type floc especially in winter to produce longer filter runs—to reduce turbidity.

For more details on the experience of scores of N-Sol users, write for data file No. 52.

N-Sol patented processes for preparing activated silica sols from our "N" Silicate of Soda are licensed without royalty.

N-Sol® Processes
PQ SOLUBLE SILICATES

PHILADELPHIA QUARTZ COMPANY
1166 Public Ledger Building, Phila. 6, Pa.

(*Continued from page* 114A)

eral layout and designing of all double line industrial and commercial pipe line systems where various sizes and types of pipe connections are used.

Actual size of indicator is 5⅜" x 9⅞", made of rigid translucent plastic that stays flat with a no-glare and non-slip surface.

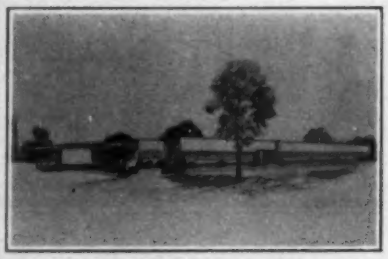
Bailey Meter Moves Boston Office

The Bailey Meter Company, Cleveland, Ohio, has announced that the Boston District office has moved to new quarters:

Bailey Meter Company
230 Congress Street
Boston 10, Massachusetts

Under the managership of P. T. Reuter, the Boston Office is staffed by Instrument Engineers K. T. Bridgman, C. B. Callahan, H. T. Griffin, C. M. Holden, F. M. Sargent, Henry Thistle, R. C. Van Der Voort, and G. D. Williams.

The Boston territory includes Rhode Island, Massachusetts, Vermont, Maine, New Hampshire, and Connecticut.



Permutit Expands Manufacturing Facilities

The Permutit Company, New York, N. Y., has announced the building of a modern metal-working plant at Lancaster, Pa.

With the foundations in and most of the steel-work installed, it is scheduled for completion by the spring of 1954. The new manufacturing plant will cost about $750,000 and will occupy 2 acres on a site of approximately 30 acres.

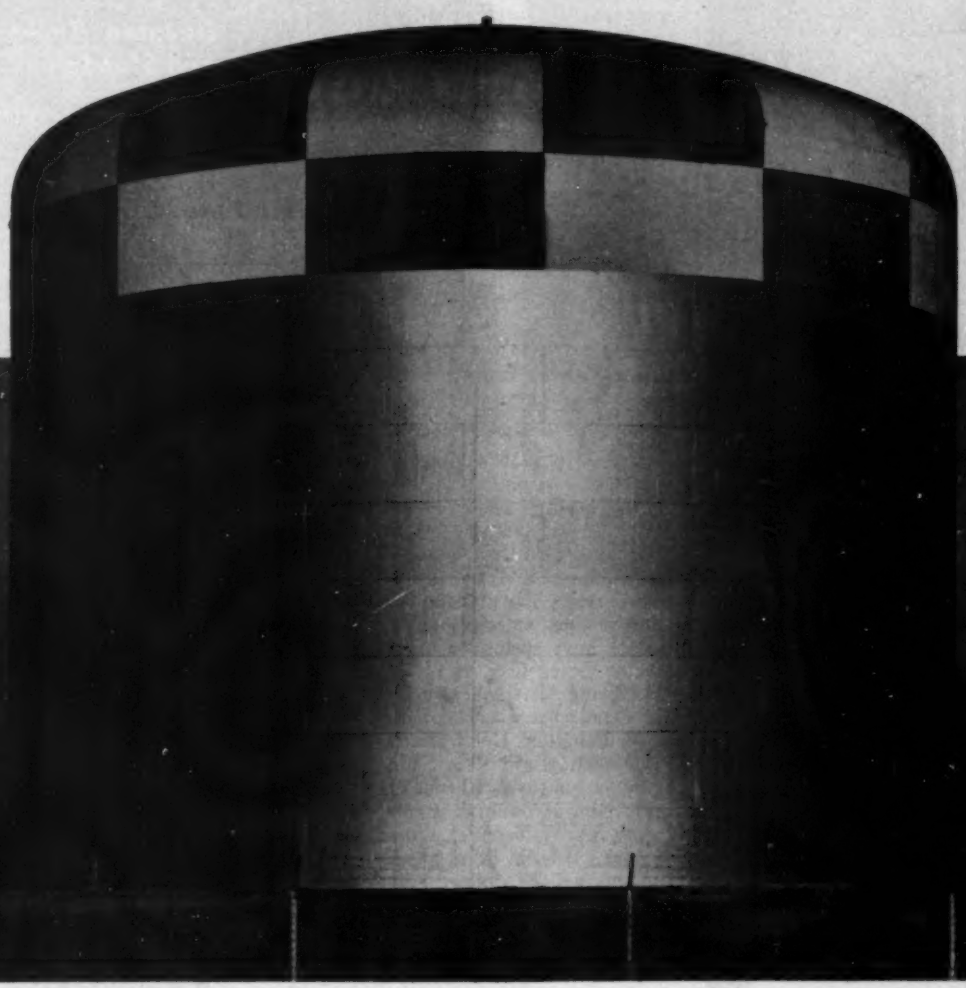
"This move," according to Mr. Foulds, President, "is the result of long-range planning and careful analysis of our present and future production facilities. The plant will be of modern design, with all facilities on one floor. It should enable us to give better service and closer attention to the needs of our customers and will provide a more suitable working space that can be expanded when required. The consolidation at Lancaster of two similar activities in

(*Continued on page* 118A)

NOW—**America's Largest Standpipe**

(CAPACITY 7,268,000 GALLONS)

for South Pittsburgh Water Company



by **PITTSBURGH •DES MOINES**

This huge water storage unit evidences typical Pittsburgh-Des Moines fine workmanship in shop fabrication and field erection. Measuring 116 feet in diameter, with a water depth of 95 feet and total capacity of 7,268,000 gallons, the South Pittsburgh Water Company giant is the largest standpipe-type storage tank built in America to date. • Let us quote on your water storage needs.

PITTSBURGH-DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

PITTSBURGH (25)	3418 Neville Island	DES MOINES (8)	919 Tuttle Street
NEWARK (2)	218 Industrial Office Bldg.	DALLAS (1)	1223 Praetorian Building
CHICAGO (3)	1222 First National Bank Bldg.	SEATTLE	526 Lane Street
LOS ANGELES (48)	6399 Wilshire Blvd.	SANTA CLARA, CAL.	625 Alviso Road

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

(*Continued from page* 116A)

plants at Brooklyn, N.Y. and Philadelphia, Pa., will effect substantial economies. It will be the finest operation of its type in the industry."

Continuing he stated, "we expect to vacate the Brooklyn, N. Y. plant early in 1954 and transfer its equipment, augmented by new production apparatus to the new location as soon as possible. Later in the year, the manufacture of Simplex Valve & Meter Company products, now produced in Philadelphia, Pa., will also be transferred to Lancaster. Neither the main executive and sales office at New York, nor the manufacturing plant at Birmingham, N. J. will be affected by this expansion move. Our long-range plan provides for the full and continued use of the Birmingham property."

Hollen Retires From Ridge Tool

Two New Representatives Appointed

Ridge Tool Company, Elyria, Ohio, has announced that C. O. "Orrie" Hollen, sales representative since 1925 in New Jersey, Pennsylvania, Maryland, Delaware, Virginia and Washington, D.C., has resigned and will retire. He plans to spend this winter in Clearwater, Florida, returning late next spring to his summer home at Ocean City, N.J.

Replacing Mr. Hollen in New Jersey, Pennsylvania east of Lewiston and Wilmington, Delaware, is Ralph W. Hamlin, from The Ridge Tool Co. home office in Elyria. His address: New Aronimink Arms, Bldg. G, Apt. 3A, Wilde Ave., Drexel Hill, Pa. Mr. Hamlin is a graduate of Baldwin-Wallace College and served two years in the Army Air Corps during World War II.

M. B. "Pat" Williams takes over Ridge Pipe Tool sales in the District of Columbia, Maryland, Delaware (except Wilmington), Virginia and North Carolina. He was with U.S. Radiator Corp. in Washington, D.C., for six years, 8½ years with Washington area Mechanical contractors, including two years with the U.S. Navy, and for the past three years has been Southern Sales Representative for a large tool company of New York City. Mr. Williams' address is 7301 Ft. Foote Road S.E., Washington 22, D.C.

MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

ROBERTS FILTER MFG. CO.
607 Columbia Ave.
Darby, Pa.

Nature's Bionetic
First Aid to Waste Treatment

INCREASE SEWAGE PLANT CAPACITY WITHOUT CAPITAL COST!

WHAT IS IT?
- BIONETIC is a dry powder of preserved beneficial groups of micro-organisms that accelerate natural biological action.

WHAT DOES IT DO?
- BIONETIC can save money on sewage plant problems including odor control, increased sludge digestion capacity, and scum blanket control.

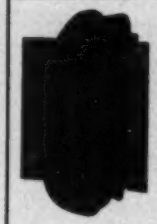
INTERNATIONAL ACCEPTANCE:
- BIONETIC is successfully used by hundreds of municipalities, industries, resorts, and institutions.

For FREE Literature Write:
A. J. Krell, technical director
Reliance Chemicals CORPORATION
P. O. BOX 6724 HOUSTON 5, TEXAS

Inspection
Repairing
Painting

Elevated Tanks and Standpipes

VIRGINIA ERECTION COMPANY
Constitution Blvd.
P.O. Box 387 Rochester, Pa.

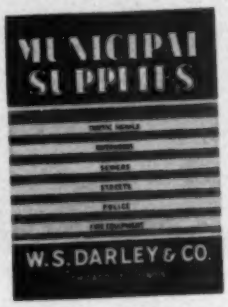


BELL JOINT LEAK CLAMPS
GASKET SEALER COMPOUND
CHARCOAL CAST IRON BOLTS

Also Anchored Glands for mechanical joints to replace socket clamps.

Write for information

H. Y. CARSON COMPANY
1221 Pinson St. Birmingham, Ala.

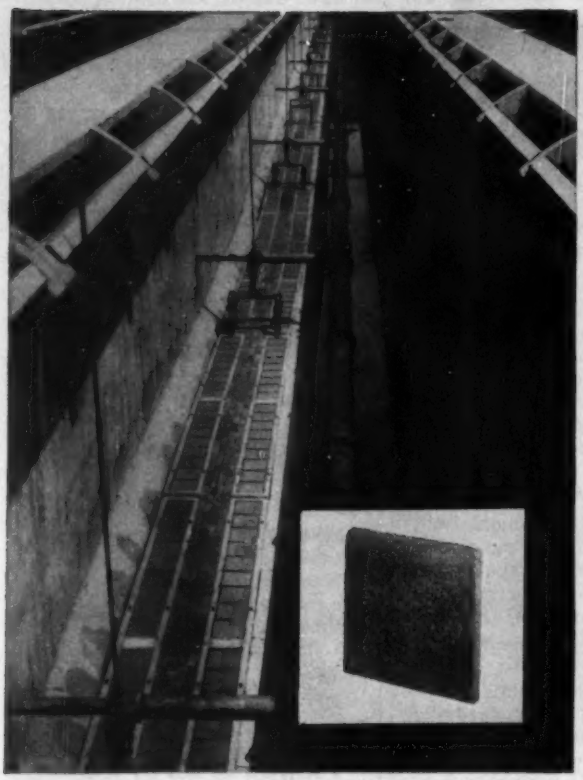


Write Today For 100 Page Catalog
W.S. DARLEY & CO., Chicago 12

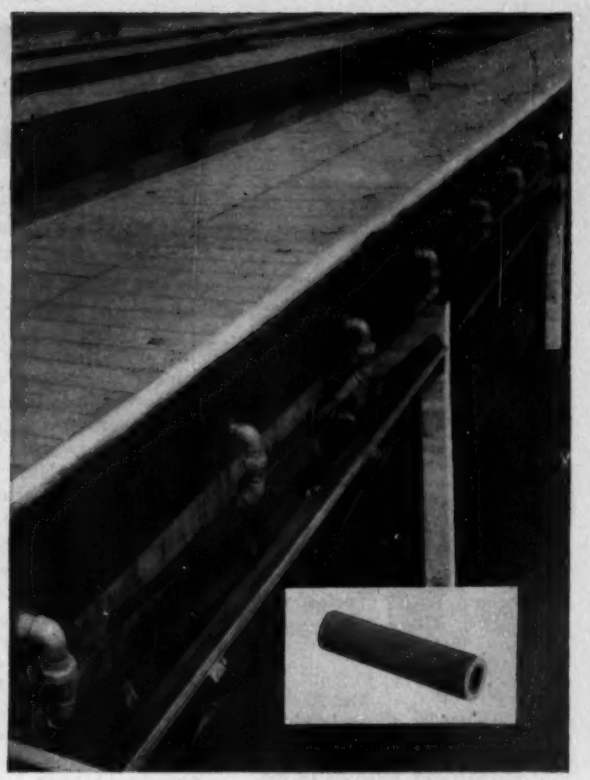
SANITARY ENGINEER

Permanent position in State Health Department. Starting salary to $5,044 and maximum to $7,202 depending upon qualifications. Liberal personnel policies.

Write: Personnel Officer
Vermont Health Department
115 Colchester Ave.
Burlington, Vermont



Installation of Norton porous plates in a sewage disposal plant.



A method of suspending Norton porous tubes in a sewage disposal plant.

ONLY UNIFORM POROSITY MEANS UNIFORM AERATION . . . and you get it only in Norton ALUNDUM* Plates and Seamless Tubes

There's only one "controlled structure" process for making porous plates and seamless tubes — and that is the Norton process.

Experiments have shown that controlled pore size and distribution are necessary for uniform aeration.

Norton ALUNDUM Porous Mediums have this — plus the additional advantages of high resistance to both alkaline and acid conditions . . . to abrasion, breakage and chipping. They spell long, trouble-free life in activated sludge sewage plants. Plates, tubes and discs are available in a wide range of sizes. Also available are plates for rapid sand filters in water filtration; seamless tubes for diatomaceous filters in swimming pools.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

GET THE FACTS. Booklet contains charts, tables and other data pointing to greater efficiency and economy in porous mediums. Ask your Norton representative or write NORTON CO., 221 New Bond St., Worcester 6, Mass.

NORTON

POROUS MEDIUMS

Making better products . . . to make other products better

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

WILKINSON LINE LOCATOR

The original—the pace setter

Built to QUALITY

strict standards

Choice of discriminating buyers everywhere

Buy Satisfaction —not 'first cost'

Get the facts first

Locates all parts of your underground system

WILKINSON PRODUCTS CO.
3987 Chevy Chase Drive
Pasadena 3, California

"couldn't do without my TAYLOR COMPARATOR for pH, CHLORINE TESTS"

That's what water works operators say in plants all over the country. Taylor Comparators give fast, easy determinations of pH, chlorine, bromine, also complete water analysis. You can make determinations anywhere in plant since Taylor Sets are lightweight, small, no trouble to carry.

EASY TO USE Operate by colorimetric comparison method. No single standards to handle. Each complete set of standards in single plastic slide.

ACCURATE No chance of mechanical inaccuracy since all Taylor Liquid Color Standards carry an unlimited guarantee against fading!

GET THE FULL STORY from your dealer, or write for free book, "Modern pH & Chlorine Control". Gives theory and application of pH and Chlorine control, illustrates and describes full Taylor line.

W. A. TAYLOR AND CO.
7308 YORK RD. • BALTIMORE 4, MD

Literature & Catalogs

Chemicals Used in Water, Sewage and Waste Treatment

212

Omega Machine Co., Providence, R.I., has produced a sixteen-page technical bulletin on **Chemicals Used in Water, Sewage and Waste Treatment** containing pertinent data and information of interest to designing engineers and supervisors of operations of water, sewage or waste treatment plants where chemicals are used in treatment processes.

The data in this technical bulletin have been compiled from various publication sources and the files of Omega Machine Co. and represent current information on 50 chemicals used in water purification and sewage and waste treatment.

It contains information on the various chemicals, their formulas, common names, most common uses, forms in which they can be obtained, sizes of shipping containers and characteristics including appearance and properties, bulk density, commercial strength and solubilities.

It also contains information on recommendations for feeding these chemicals with particular reference to the best form for feeding, the amount of water required for continuous dissolving, types of feeders, accessory equipment required and suitable materials for handling both the dry chemicals and solutions.

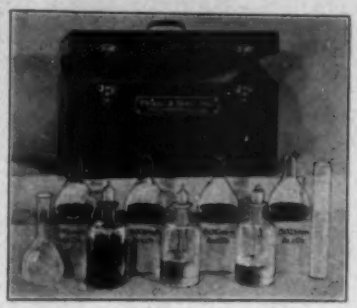
Also contained in the technical bulletin is a Table of Chemical Uses showing where these 50 chemicals are used in water, sewage, and waste treatment processes.

Flow Measurement in Sewage Treatment

213

Minneapolis-Honeywell Regulator Co. has just published an Instrumentation Data Sheet that discusses the primary elements and instrumentation for **Flow Measurements in Sewage Treatment Plants.** The advantageous application of pneumatic transmission, ratio control, and mercuryless manometers in actual installations is explained together with successful applications of the more familiar types of instruments. This data sheet will be of interest to sanitary engineers as a ready reference.

BALDWIN ALUMINA SET



For quickly determining the residual alum in filtered water. The complete apparatus includes reagents, color standards and portable hardwood carrying case. The case protects the apparatus from possible contamination with alum dust. Complete with directions for use.

82-760 .....Each $65.00

Write

Phipps & Bird, Inc.
6th & Byrd St., Richmond, Virginia
(2305 Rhode Island Ave., N.E., Washington, D.C.)

ROTO-TROL 940

CONTROLS that are dignified by a background of long experience and infallible operation. *ROTO-TROL 940* controls pumps, valves, alarm circuits, etc., from one float. Starting and stopping positions, rising and falling, can be set as required. Each circuit is independent. Mercury switches with snap action are used. *ROTO-TROL 940* can be easily set on the job.

Write for Bulletins

Water Level Controls Division
HEALY-RUFF Company
783 HAMPDEN AVE., ST. PAUL 4, MINN.

perfect alignment

no ground water infiltration

G HUBARD MASSEY, MASCE

G BYRON MASSEY, ASCE

MASSEY ENGINEERS
CONSULTANTS
FAIRFAX, VIRGINIA
CRESENT 362 469

Johns-Manville Sales Corporation
826 Woodward Building
Washington 5, D.C.

Attention: Mr. J. R. Allen, Jr.

Gentlemen:

Please furnish us with the list of diameters in the two strength classifications for sewer pipe and provide us with the trench loading tables separately for each classification using standard trench widths for Fairfax County with 120 and 130 lbs. per cubic foot earth loadings.

We have just completed inspection for ground water infiltration in the joints of six miles of trunk sewers laid in the Town of Fairfax, Virginia of which 6,000 feet of your 14" Asbestos Transite sewer pipe Class 1 with your standard joint was used.

Visual inspection was made from manhole to manhole and the pipe was found to be in perfect alignment and grade and no leaks were observed in either pipe or manholes. Tests for ground water infiltration were made at each manhole and at the end of the line, allowing twenty-four hours for accumulation of any water in the pipe line.

No ground water infiltration was found and the only moisture observable in the entire length of 6,000 feet of your sewer was condensation draining from the manholes although the sewer was laid parallel with and 4 feet below the middle fork of Accotink Creek, crossing and re-crossing many times.

This is the first sewer line which we have designed and tested in forty-three years of experience that has been bone dry at final inspection.

Yours sincerely,
MASSEY ENGINEERS

G. Hubard Massey

GHM/man

bone dry

On the basis of reduced infiltration, savings in installation cost and economies resulting from design, you are sure of a performance-proven, asbestos-cement sewer pipe when you specify Transite. Johns-Manville, Box 60, New York 16, N. Y.

JM PRODUCTS

Johns-Manville TRANSITE SEWER PIPE

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

HYDRO-TITE

DEPENDABLE JOINTING COMPOUND

Seals Bell and Spigot Water Mains

Economical—Effective

Over 35 Years Of Dependable Performance

HYDRAULIC DEVELOPMENT CORP.

MAIN SALES OFFICE 50 CHURCH ST., N. Y. C.

General offices and works W. Medford Sta., Boston, Mass.

Equipment for Chemical Flocculation

214

Link-Belt Co., Colman, Pa., has just published a booklet titled **"Equipment for Chemical Flocculation."**

Included with this catalog are 5 planotype drawings showing the general arrangement of the Flash Mixers and Straightline Mixers.

This booklet illustrates and describes equipment for both bulk and packaged chemicals handling and, with the drawings, gives complete and comprehensive design data on Link-Belt Flash Mixers and Straightline Mixers. The drawings contain design examples and detailed specifications on the reverse side.

Spray-Type Deaerating Heaters

215

Graver Water Conditioning Co., New York, N. Y., has published a new bulletin on **Spray-type Deaerating Heaters.**

The bulletin explains the specific functions and requirements of Deaerating Heaters, describes their design and operation in detail, and outlines the accessory equipment for best results. The illustrations include complete sectional drawings and representative installation photographs of both horizontal and vertical designs, together with flow charts of units in typical applications.

Automatic Chlorine Feeders

216

Everson Manufacturing Corp., Chicago, Ill., has released a leaflet on the **Air-O-Matic Automatic Chlorine Gas Sterelator,** for automatically proportioning gas feed to water flow.

The leaflet, by means of text and line drawings discusses the component parts and their operation. An attractive 4-color flow chart shows the complete operation of the units, and typical lay-out diagrams complete the leaflet.

Turbine Pumps

217

Johnston Pump Company, Pasadena, Calif., has released a bulletin on **Water Lubricated Turbine Pumps.**

A feature of the bulletin is the center spread which shows an ex-

(*Continued on page* 124A)

S&L Smith & Loveless, Inc.

3427 BROADWAY, KANSAS CITY, MISSOURI

Write for your free copy of our Engineering Data Manual, containing full details on Smith & Loveless Pumping stations.

STEEL PIPE helps cut cost of Philadelphia's long-range program of waterworks improvement

The tracks you see in the first photo below are part of the Pennsylvania Railroad's main line. That's one reason why the pipes passing under the tracks are built of strong, *electric welded steel.*

Engineers know from experience that Alco Electric Welded Steel Pipe has the strength and resilience to absorb vibration, impact and overloading that destroy pipe of other types. They know, too, that Electric Welded Steel Pipe offers still other advantages that help cut piping costs. For example: *Efficiency*—Smooth, tar-enameled inside surface gives excellent rate of flow. *Economy*—not only is first cost low but sections are long and light, for fast, easy installation. And *durability*—estimated life is 75 to 100 years.

Alco makes Electric Welded Steel Pipe to meet AWWA and other specifications. Forty-foot lengths fabricated without girth seams in diameters of 30 in. and above. Under 30 in., lengths of 22 ft furnished without girth seam, or 40-ft lengths with one girth seam. Diameters range from 20 in. to 120 in.

Use Alco Electric Welded Steel Pipe for your piping projects. Your nearest Alco Products Sales Representative will be happy to furnish you complete technical information and to discuss with you any special problems you may have.

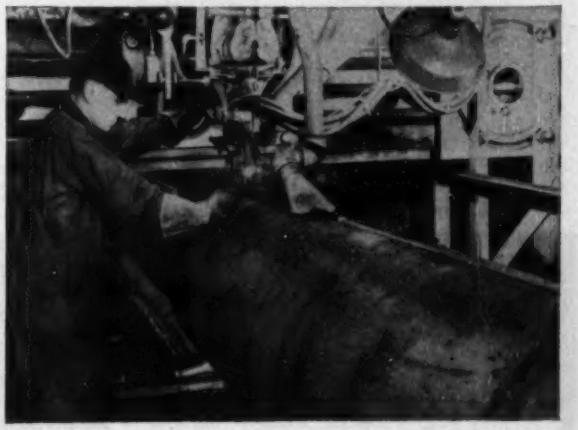
Remember these Key features of Alco Steel Pipe

STRONG: Unaffected by vibration. Maximum resistance to shock, and to overloading due to earth movement and washouts.

EFFICIENT: Positively watertight. Minimum number of field joints. Smooth surfaces for highest rate of flow.

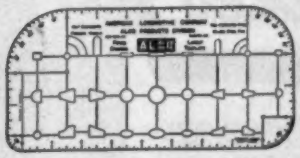
ECONOMICAL: Low first cost. Long lengths, light weight, for easy installation.

DURABLE: Life in water-supply installations estimated conservatively at 75 to 100 years.



SUBMERGED-ARC WELDING gives added strength, zero leakage. Machine shown here is part of the complete, modern facilities that enable Alco to build low-cost pipe for almost any project.

PHILADELPHIA used efficient, durable Alco Electric Welded Steel Pipe in diameters of 60, 54 and 48 in., with thicknesses of ½ and 7/16 in. Sections are joined with Dresser couplings.



For information on how to obtain one of these handy Alco Piping Templates, write to your nearest Alco Products Sales Office.

ALCO

ALCO PRODUCTS DIVISION
AMERICAN LOCOMOTIVE COMPANY
DUNKIRK, N. Y.

Sales Offices: New York, Chicago, Dunkirk, Los Angeles Kansas City, Houston, Tulsa and Beaumont.

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

GATE OPERATORS
—
PORTABLE
—
FOR STANDS & UNDERGROUND GATES—MOTOR TRUCK MOUNTED
PAYNE DEAN & CO.
CLINTON, CONN.

(*Continued from page 122A*)

ploded-cut-away drawing of the complete pump. Each part is completely described and arrows point out each part. Both the semi-open and closed impellers are discussed. Oil-lubricated pumps are discussed briefly in the back of the bulletin.

3-D Laboratory Planning

218

Labline, Inc., Chicago, Illinois, has developed a new three-dimensional technique for the efficient planning of new laboratories or additions to existing facilities.

The new 3-D laboratory planning kit consists of 26 accurately scaled three-dimensional models which correspond to those of the full size sectional metal furniture described in the 28-page catalog which comes with the kit. Also included are ruled layout sheets scaled ½ inch to the foot.

Models are imprinted in detail and once assembled and placed on the layout sheets, arranging and rearranging of various combinations or layouts can be worked out with greater efficiency than can be achieved in any other manner. Interested plant officials are able to envision exactly how the finished lab will appear, as the scale model layout demonstrates the flexibility of the units for every type of laboratory.

Water Works Catalog

219

Mueller Co., Decatur, Illinois, has just published a completely new catalog covering its entire line of water works distribution and service products. This new **Water Works Catalog** supersedes all previous editions, supplements and literature pertaining to Mueller water works products.

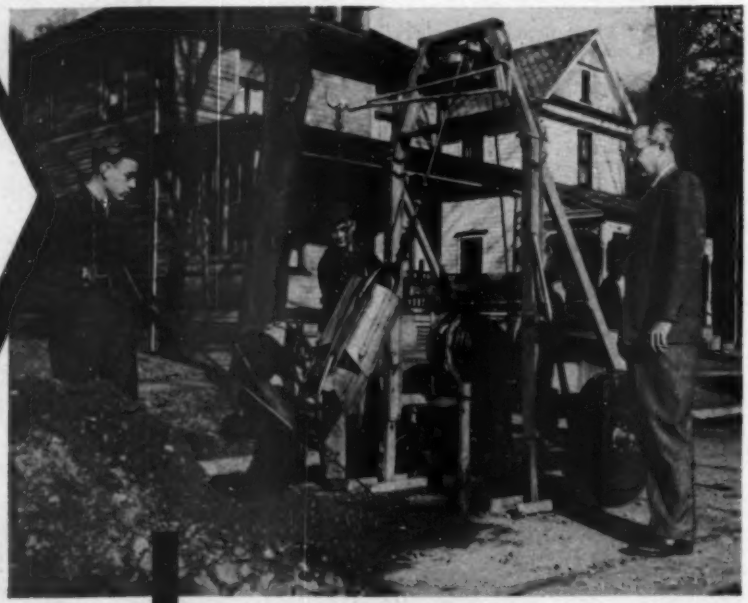
The catalog features an easy-to-use sectional indexing system to facilitate quick reference to any of the hundreds of products listed. Photographs and parts drawings are shown for nearly all items and a large section of useful engineering information is included.

Jar Test Procedure For Activated Silica Sol

220

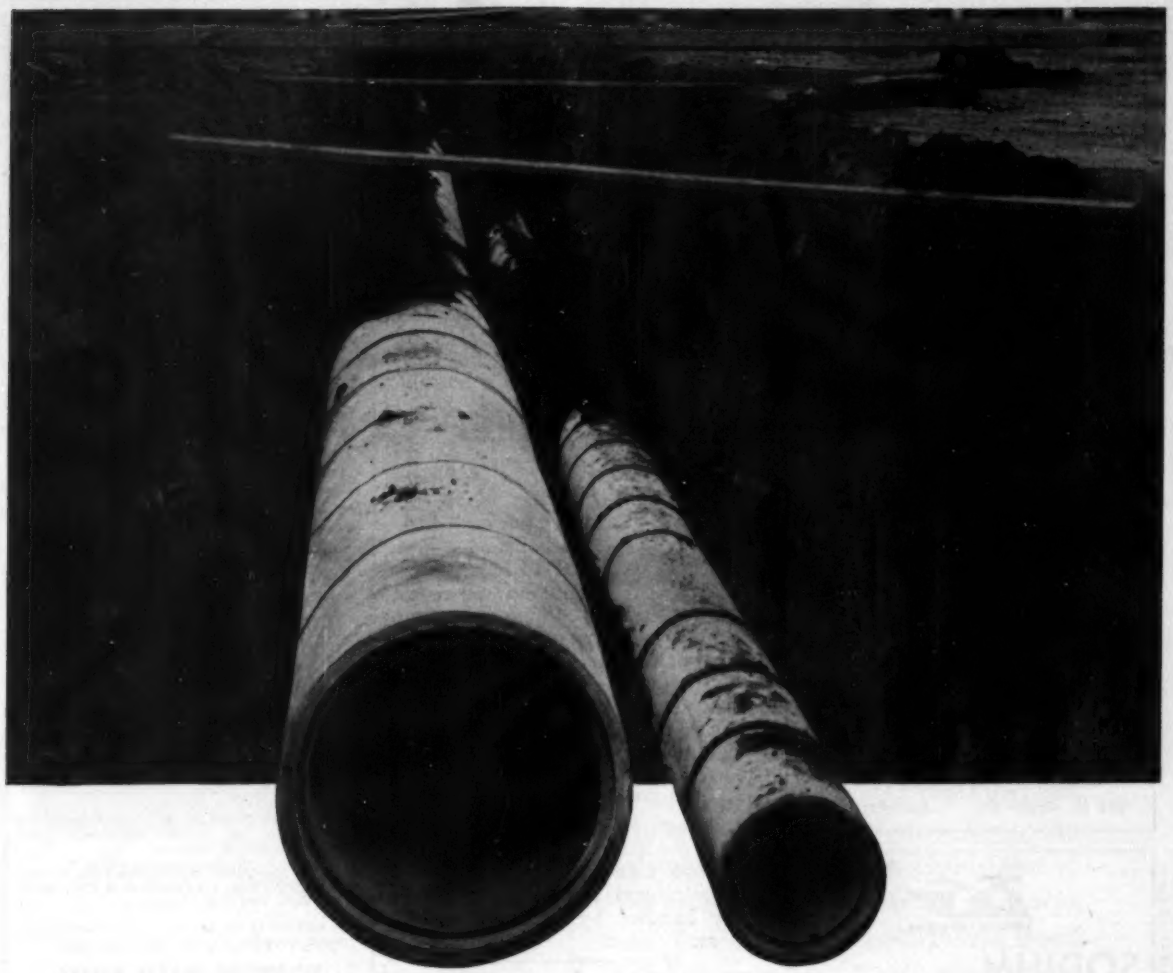
Philadelphia Quartz Company, Philadelphia, Pa., has announced the publication of an instruction sheet for conducting **Jar Tests Using Ac-**

Another
TYPICAL TOWN
saving money with
"Flexibles"



Franklin, Pennsylvania, is one of many typical American towns that use "Flexible" sewer-cleaning equipment. Shown is a Model 23R6 "Flexible" Fower Bucket Machine – the pile of dirt representing "part of one day's work!" Wm. May, in charge of sewer maintenance, is operating the machine . . . while Mayor-Elect R. R. Bleakley, presently Chairman of the Streets and Sewer Committee, watches the operation. Mr. Bleakley, together with Mr. J. McKee Snow, City Engineer, was largely instrumental in choosing "Flexibles," after careful tests. The need for "Flexibles" was so great that two shifts are being used to clean the city's sewers. Here is a city that is so greatly pleased with the results they recommend "Flexible" equipment highly.

Write for our **FREE** *Catalog*
Flexible SALES CORPORATION
3786 Durango Ave., Los Angeles 34, Calif.
(DISTRIBUTORS IN PRINCIPAL CITIES)
AMERICA'S LARGEST LINE OF PIPE CLEANING TOOLS AND EQUIPMENT



Storm Water or Sewage . . . You can solve your sewer problems with *CONCRETE PIPE*

Whether you plan a storm sewer, sanitary sewer or combination of both in one trench as in the photo above, concrete pipe will solve your problem. You get better, longer, more economical service from concrete pipe because:

1. Concrete pipe's great strength resists severe impact and sustains heavy overburdens.

2. Concrete pipe's uniformly dense structure along with its watertight joints will assure minimum infiltration and leakage in the sewer line.

3. Concrete pipe's smooth interior finish resists the wearing action of suspended abrasive matter and provides maximum hydraulic capacity.

4. Concrete pipe's unusual durability results in long service. Many concrete pipe sewers have been serving for 60, 80, 100 or more years.

5. Concrete pipe's first cost is moderate, its service life extra long, its maintenance cost extra low. The result is *low-annual-cost* service—the only true measure of sewer line economy.

AMERICAN CONCRETE PIPE ASSOCIATION

228 NORTH LA SALLE STREET, CHICAGO 1, ILLINOIS

● If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

CAST IRON PIPE
AND FITTINGS
Phone or Write
McWANE Cast Iron Pipe Company, Birmingham, Ala.
Pipe sizes 2" thru 12"
PACIFIC STATES Cast Iron Pipe Co., Provo, Utah
Pipe sizes 2" thru 24"
Sales Offices Principal Cities

Servicing Water Holders All Types Elevated and Standpipes.
Specially designed materials that hold down corrosion.
IT'S THE APPLICATION THAT COUNTS
All guaranteed work.
SPEELMON ELEVATED TANK SERVICE
Complete Painting & Repair Service
822 N. Court St. Rockford, Ill.

TG TENNESSEE CORPORATION
SODIUM FLUOSILICATE
(Silico Fluoride)
Inquiries Invited
TENNESSEE CORPORATION
1028 Connecticut Ave., Wash. 6, D.C.

ANTHRAFILT
Trade Mark Reg. U. S. Patent Office
A Filter Medium For All Purposes
ANTHRACITE EQUIPMENT CORP.
Anthracite Institute Building
Wilkes-Barre, Pa.
All correspondence regarding sales and engineering should be addressed to:
PALMER FILTER EQUIPMENT CO.
822 E. 8th St. Erie, Pa.
Engineers and Sales Agents

tivated Silica Sol as coagulating aid. Jar test evaluations are important pre-steps to full-scale plant run of activated silica sol for the treatment of raw and waste waters.

The method of producing a sol by reacting silicate of soda with a reacting chemical is carefully presented in a step-by-step outline. Instructions are included for clarification of special water conditions such as low turbidities and low temperatures, high turbidities and color and in lime softening operations. This data sheet is available together with jar test forms.

"Transporter" Pneumatic Handling Method

221

Yeomans Brothers Company, Chicago, Ill., has just published a new 8-page **"TRANSPORTER" Bulletin** that includes problem-solution-result reports covering foundry, meat packing, tannery and municipal waste handling installations. In each case, the materials handled are comparable to those found in other industries.

According to the bulletin, "Transporter" handling systems, designed around the Yeomans "Transporter" Pneumatic Ejector, are used primarily for handling heavy materials that cannot be successfully handled by centrifugal pumps or economically handled by mechanical conveyors.

Main-Line Water Metering

222

Sparling Meter Company, Inc., Los Angeles, Calif., has available a new catalog on **Sparling Water Control Equipment.**

This attractive, well illustrated catalog covers the complete line of main-line meters, instruments for use with the meters and controls. Construction details and specifications are also included. A two-page, 2-color chart gives complete accuracy and head loss curves for the meters. A list branch office locations are given on the back cover.

Municipal Waste Pumps

223

Marlow Pumps, Ridgewood, New Jersey, has just released a new 12 page bulletin on **Municipal and Industrial Waste Pumps.** The new booklet covers features, performance information, specifications and selection data for plunger sludge pumps, mud-hog diaphragm pumps, and self-priming centrifugal pumps used on sludges and slurries.

FOR SALE
New Dresser Couplings
At a Tremendous Saving
190—Coupling 12" C.I. pipe, style #38 ⅝ x 7" M.R. W/O stops, complete W/H.D. bolts, W/O gaskets. Price: $6.00 ea.
18—Couplings 44", Steel pipe, style #38, ⅝ x 10" middle ring, W/O stops, complete with hot-dip galvanized bolts, and nuts, W/O gaskets. Price: $40.00 ea.
34—Steel pipe armored coupling 44" gaskets, style #38, grade #27. Price: $6.00 ea.
DALTON SUPPLY CO.
718-16th Ave., Belmar, N.J.

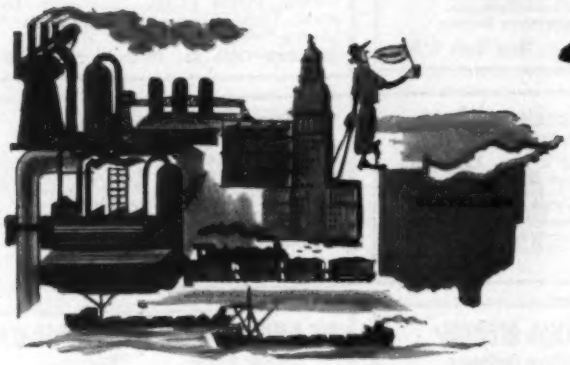
SANITARY ENGINEER WANTED
Graduate Sanitary Engineer or Sanitary Chemist, preferably with 2-3 years experience, for Application and Sales Engineering work with well known manufacturer of sewage and industrial waste treatment equipment, New Jersey area.
Reply: Box 1118
WATER & SEWAGE WKS.
185 N. Wabash Avenue
Chicago 1, Illinois

For Sale
Pump No. 1.—Fairbanks-Morse Pomona Turbine, 15 horse power—Electric, 150 G.P.M., 1750 R.P.M., 3 phase, 60 cycle, 220 or 440 volts, 300' head, Style 1073614, Serial AK 1001.
Pump No. 2.—Frederick Pump, Centrifugal, 100 G.P.M., 400' head, 2,000 R.P.M., Serial 9,966, Size 2½", 3 Stage pump.
Pump No. 3.—Pomona Turbine Pump, 100 G.P.M., 300' head, 60 cycle motor, 1465 R.P.M., Serial S.D. 2248, Steel Tower Mounting.
In addition to the pumps, we also have fittings, switch boxes etc.
KINGWOOD WATER WORKS
Kingwood, West Virginia

WANTED
Sewage Treatment Plant Superintendent
For plant located in New England. Man to have responsibility of operating and maintaining a new sewage treatment plant and a system of interceptor sewers.
Must be experienced in operation and maintenance of large sewerage works and must be graduate engineer.
Reply by letter giving pertinent particulars to Box #1117.
WATER & SEWAGE WORKS
185 North Wabash Avenue, Chicago 1, Illinois

WANTED
Position desired in Texas as Manager or Water & Sewage Supt. Am 30 years of age, married and have family. Have B Water, B Sewage and Plumbing Inspector's License with approximately 8 years' experience in management, maintenance and construction work. Will furnish the best of references and complete record of application if desired.
Reply: Box 1116
WATER & SEWAGE WORKS
185 North Wabash Avenue, Chicago 1, Illinois

Cleveland Prefers Concrete Pressure Pipe



Economy was a decisive factor in Cleveland's selection of concrete pressure pipe for its water supply system. This seventh ranking city in the nation, with an average daily water consumption of 272 mgd., found that the low original cost of concrete pressure pipe, together with its remarkably long life and excellent flow characteristics, made it a sound investment.

In 1940 the first concrete pressure pipe was laid in Cleveland. Since that time several additional installations have been made, one of these being the Nottingham intake. Here, 10,000 feet of 120 inch concrete pressure pipe was used. Just recently the Northfield Road Main was completed. This job, stretching for over 4 miles, used concrete pressure pipe in diameters ranging from 30 to 42 inches.

Efficient, economical concrete pressure pipe is available in a wide range of diameters and can be installed to fit the individual requirements of large or small communities.

Water for Generations to come

Concrete Pressure Pipe

AMERICAN CONCRETE PRESSURE PIPE ASSOCIATION
228 North LaSalle Street
Chicago 1, Illinois

Consulting Engineers

SPECIALIZING IN THE FIELD OF

WATER & SEWAGE WORKS

ALBRIGHT & FRIEL INC.
Consulting Engineers
Water, Sewage and Industrial Wastes Problems
Airfields, Refuse Incinerators, Dams
Power Plants, Flood Control
Industrial Buildings
City Planning, Reports, Appraisals and Rates
Laboratory
121 SOUTH BROAD ST. PHILADELPHIA 7

Clinton L. Bogert Associates
CONSULTING ENGINEERS
Clinton L. Bogert — Ivan L. Bogert
Robert A. Lincoln — Donald M. Ditmars
Water & Sewage Works
Refuse Disposal — Industrial Wastes
Drainage — Flood Control
624 Madison Avenue, New York 22, N.Y.

The Chester Engineers
Water Supply and Purification—Sewage and Industrial Waste Treatment—Power Plants—Incineration—Gas Systems—Valuations — Rates — Management — Laboratory—City Planning
210 E. Park Way,
Pittsburgh 12, Penna.

Alvord, Burdick & Howson
Engineers
Water Works, Water Purification, Flood Relief, Sewerage, Sewage Disposal, Drainage, Appraisals, Power Generation
20 N. Wacker Drive, Chicago 6, Ill.

Bowe, Albertson & Associates
Engineers
Water and Sewage Works
Industrial Wastes—Refuse Disposal—Municipal Projects
Airfields—Industrial Buildings
Reports—Designs—Estimates
Valuations—Laboratory Service
110 William St. New York 7, N.Y.

CONSOER, TOWNSEND & ASSOCIATES
Water Supply, Sewerage, Flood Control & Drainage, Bridges, Express Highways, Paving, Power Plants, Appraisals, Reports, Traffic Studies, Airports, Gas & Electric Transmission Lines.
351 East Ohio St., Chicago 11, Illinois

JOHN J. BAFFA
Consulting Engineer
Water Supply and Treatment
Sewerage and Sewage Treatment
75 West Street New York 6, N. Y.

Buck, Seifert and Jost
Consulting Engineers
(Formerly Nicholas S. Hill Associates)
Water Supply, Sewage Disposal, Hydraulic Developments, Reports, Investigations, Valuations, Rates, Design Construction Operation Management, Chemical and Biological Laboratories
112 East 19th St. New York

Cotton, Pierce, Streander, Inc.
Associated Engineering Consultants
122 Nassau St., New York, N.Y.
P.O. Box 190, Hyde Park 36, Mass.
1405 W. Erie Ave., Phila. 40, Pa.
55 Caroline Rd., Gowanda, N.Y.
Water Supply Treatment, Distribution, Sewerage, Sewage Treatment
Refuse Disposal, Trade Wastes
Power Plants
Reports, Plans, Supervision.

Michael Baker, Jr.
The Baker Engineers
CIVIL ENGINEERS AND PLANNERS
MUNICIPAL ENGINEERS
Airport Design—Sewage Disposal Systems
Water Works Design and Operation
Consulting Services—Surveys and Maps
HOME OFFICE—ROCHESTER, PA.

BURGESS & NIPLE
Civil and Sanitary Engineers
Water Supply and Purification
Sewerage and Sewage Treatment
Appraisals, Reports, Valuations
2015 West Fifth Avenue
Columbus 12, Ohio

DE LEUW, CATHER & COMPANY
Water Supply — Sewerage
Railroads — Highways
Grade Separations—Bridges—Subways
Local Transportation
Investigations — Reports — Appraisals
Plans and Supervision of Construction
150 North Wacker Drive Chicago
79 McAllister Street San Francisco 2, Calif.

W. H. & L. D. BETZ
CONSULTING ENGINEERS
INDUSTRIAL WASTE
INDUSTRIAL WATER
ANALYSIS — DESIGN
INVESTIGATIONS — OPERATION
Gillingham & Worth Sts.
Philadelphia 24, Pa.

BURNS & McDONNELL
Consulting and Designing Engineers
Kansas City, Mo. — Cleveland, Ohio
P.O. Box 7088 — 1404 E. 9th St.

FAY, SPOFFORD & THORNDIKE
Engineers
Charles M. Spofford — Ralph W. Horne
John Ayer — William L. Hyland
Rice A. Bowman — Frank L. Lincoln
Carroll A. Farwell — Howard J. Williams
Water Supply and Distribution—Drainage
Sewerage and Sewage Treatment
Airports—Bridges—Turnpikes
Port and Terminal Works — Industrial Bldgs.
Investigations, Reports, Designs, Valuations
Supervision of Construction
BOSTON NEW YORK

MR. CONSULTING ENGINEER
Are you interested in both
WATER & SEWAGE
If so there is no better place for your professional card than in this dual interest magazine.
WATER & SEWAGE WORKS

Camp, Dresser & McKee
Consulting Engineers
6 Beacon Street, Boston 8, Mass.
Water Works and Water Treatment; Sewerage and Sewage Treatment; Municipal and Industrial Wastes; Investigations and Reports; Design and Supervision; Research and Development; Flood Control.

Finkbeiner, Pettis & Strout
Carleton S. Finkbeiner, C. E. Pettis, Harold K. Strout
Consulting Engineers
Reports Designs Supervision
Water Supply, Water Treatment, Sewerage, Sewage Treatment, Wastes Treatment, Valuations & Appraisals.
518 Jefferson Avenue Toledo 4, Ohio

BLACK & VEATCH
Consulting Engineers
Water — Sewage — Electricity
Industry
Reports, Design, Supervision of Construction, Investigations, Valuation and Rates
4706 Broadway, Kansas City 2, Missouri

CAPITOL ENGINEERING CORPORATION
Engineers—Constructors—Management
SEWAGE SYSTEMS — WATER WORKS
Designs and Surveys — Roads and Streets
Planning — Airports
Bridges — Dams
Executive Offices
DILLSBURG, PENNSYLVANIA

Freese, Nichols and Turner
CONSULTING ENGINEERS
2111 NATIONAL STANDARD BUILDING
HOUSTON 2, TEXAS
CH-1624

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Engineers
Pittsburgh, Pa. Daytona Beach, Fla.
HARRISBURG, PA.
Water Works, Sewage, Industrial Wastes and Garbage Disposal—Roads, Airports, Bridges, Flood Control, Traffic & Parking, Appraisals, Investigations & Reports.

MR. CONSULTING ENGINEER
Are you interested in both
WATER & SEWAGE
If so there is no better place for your professional card than in this dual interest magazine.
WATER & SEWAGE WORKS

Malcolm Pirnie Engineers
Civil and Sanitary Engineers
Malcolm Pirnie — Ernest W. Whitlock
Robert D. Mitchell — Carl A. Arenander
Malcolm Pirnie, Jr.
Investigations, Reports, Plans
Supervision of Construction and Operations
Appraisals and Rates
25 West 43rd St., New York 36, N. Y.

GILBERT ASSOCIATES, INC.
Engineers and Consultants
Water Supply and Purification
Sewage and Industrial Waste Treatment
Chemical Laboratory Service
Investigations and Reports
New York — Reading, Pa. — Washington
Houston — Philadelphia

Jones, Henry & Williams
Consulting Sanitary Engineers
Water Works
Sewerage & Treatment
Waste Disposal
821 Security Bldg. — Toledo 4, Ohio

THE PITOMETER COMPANY
Engineers
Water Waste Surveys
Trunk Main Surveys
Water Distribution Studies
Water Measurements & Special Hydraulic Investigations
New York. — 50 Church Street

GLACE AND GLACE
Consulting Sanitary Engineers
WATER SUPPLY AND PURIFICATION
SEWERAGE AND SEWAGE TREATMENT
Design, Construction and Supervision of Operation
1001 North Front St. — Harrisburg, Pa.

Engineering Office of CLYDE C. KENNEDY
SANITARY ENGINEERING
SAN FRANCISCO

LEE T. PURCELL
Consulting Engineers
Water Supply & Purification; Sewerage & Sewage Disposal; Industrial Wastes; Investigations & Reports; Design; Supervision of Construction & Operation
Analytical Laboratories
38 De Grasse Street — Paterson 1, N.J.

GREELEY AND HANSEN
Engineers
Samuel A. Greeley — Paul Hansen (1920-1944)
Paul E. Langdon — Kenneth V. Hill
Thomas M. Niles — Samuel M. Clarke
Water Supply, Water Purification
Sewerage, Sewage Treatment
Flood Control, Drainage, Refuse Disposal
220 S. State Street, Chicago 4

Morris Knowles, Inc.
Engineers
Water Supply and Purification, Sewerage and Sewage Disposal, Valuations, Laboratory, City Planning
1312 Park Building, Pittsburgh, Pa.

Thomas M. Riddick
Consulting Engineer and Chemist
Municipal and Industrial Water Purification, Sewage Treatment, Plant Supervision, Stream Pollution Investigations, Chemical and Bacteriological Analyses.
369 East 149th Street
New York 55, N. Y.

HAVENS AND EMERSON
W. L. HAVENS — C. A. EMERSON
A. A. BURGER — F. C. TOLLES — F. W. JONES
W. L. LEACH — H. H. MOSELEY — J. W. AVERY
CONSULTING ENGINEERS
WATER, SEWERAGE, GARBAGE, INDUSTRIAL WASTES VALUATIONS—LABORATORIES
LEADER BLDG. CLEVELAND 14, O. — WOOLWORTH BLDG. NEW YORK 7, N.Y.

WM. S. LOZIER CO.
Sewerage, Sewage Disposal, Water Supply, Water Purification
Refuse Disposal
Consulting Engineers
10 Gibbs Street — Rochester 4, N. Y.

ROBERT AND COMPANY ASSOCIATES
Architects & Engineers
• ATLANTA •
WATER SUPPLY • INCINERATORS
SEWAGE DISPOSAL • POWER PLANTS

Hayden, Harding & Buchanan
Consulting Engineers
John L. Hayden
John H. Harding — Oscar J. Campia
Waterworks, Sewerage, Civil, Mechanical, Electrical, Structural
810 Park Square Building, Boston, Mass.

Metcalf & Eddy
Engineers
Water, Sewage, Drainage, Refuse and Industrial Waste Problems
Airfields — Valuations
Laboratory
Statler Building, Boston 16

RUSSELL AND AXON
Consulting Engineers
Civil—Sanitary—Structural
Industrial—Electrical
Rate Investigations
408 Olive St., St. Louis 2, Mo.
Municipal Airport, Daytona Beach, Fla.

HAZEN AND SAWYER
Engineers
Richard Hazen — Alfred W. Sawyer
Municipal and Industrial Water Supply
Purification and Distribution
Sewage Works and Waste Disposal
Investigations, Design,
Supervision of Construction and Operation
110 East 42nd Street — New York 17, N.Y.

Nussbaumer, Clarke & Velzy, Inc.
Newell L. Nussbaumer—Irving Clarke—Charles R. Velzy
Water Supply and Treatment
Sewerage & Sewage Disposal
Garbage Incineration
Municipal Planning
500 Fifth Avenue, New York 36, New York
327 Franklin St. — Buffalo, N. Y.

MILES O. SHERRILL
Consulting Engineers
Marion C. Welch, Associate Engineer
Water Purification & Distribution—Sewerage & Sewage Disposal—Valuations & Reports—Dams, Reservoirs and Area Drainage—Swimming Pools—Streets & Storm Drainage—Garbage Incineration.
Frank S. Whitney, Principal Engineer
Tri-State Airport — Huntington, W.Va.
"The Sherrill Engineers"
1412 Bardstown Road — Louisville 4, Ky.

The Jennings-Lawrence Co.
Civil & Municipal Engineers
Consultants
Water Supply, Treatment & Distribution
Sewers & Sewage Treatment
Reports — Design — Construction
1382 King Ave. — Columbus 12, Ohio

PARSONS, BRINCKERHOFF HALL & MACDONALD
G. Gale Dixon, Associate
Civil and Sanitary Engineers
Water, Sewage, Drainage and Industrial Waste Problems.
Structures — Power — Transportation
51 Broadway — New York 6, N.Y.

J. E. SIRRINE Company
Engineers
Water Supply & Purification
Sewage & Industrial Waste Disposal
Stream Pollution Reports
Utilities, Analyses
Greenville — South Carolina

Additional Engineers Cards on Next Page

CONSULTING ENGINEERS

Specializing in the Field of

WATER AND SEWAGE WORKS

Continued

Alden E. Stilson & Associates
Limited
Consulting Engineers
Water Supply—Sewage—Waste Disposal
Bridges—Highways—Industrial Buildings
Studies—Surveys—Reports
208 S. High St. Columbus, Ohio

Weston & Sampson
Water Supply, Water Purification, Sewerage, Sewage and Industrial Waste Treatment, Corrosion Control, Laboratory Service Supervision, Valuations
14 Beacon St. Boston, Mass.

Benjamin L. Smith & Associates
Engineers
Investigations — Reports
Designs — Supervision — Valuations
Municipal Engineering and Public Utilities
11 North Pearl Street
Albany 7, New York

WARREN O. WAGNER
Consulting Hydraulic Engineers
Water Distribution Systems
Plans and Specifications
Investigations - Reports
Ground Water Studies
Domestic and Irrigation Water Problems
Consultation
740 EAST WALNUT PASADENA 4, CALIF.

Whitman & Howard
Engineers (Est. 1869)
Water Supply, Water Purification, Sewerage, Sewage Disposal, Water Front Improvements and all Municipal and Industrial Development Problems, Investigations, Reports, Designs, Supervision, Valuations.
89 Broad St., Boston, Mass.

SPANSKI and WILLIAMSON
Engineers — Geologists
Groundwater Exploration
Investigations and Reports
P.O. Box 151
Springfield, Illinois

Wertz Engineering Co., Inc.
Consultants, Designers & Constructors
Water Supply & Purification
Sewage & Industrial Waste Treatment
Stream Pollution Studies
Chemical & Bact. Laboratory Service.
441 North 2nd St. Reading, Pa.

WHITMAN, REQUARDT & ASSOCIATES
Engineers — Consultants
Civil—Sanitary—Structural—
Mechanical—Electrical
Reports, Plans, Supervision, Appraisals
1304 St. Paul Street
Baltimore 2, Maryland

STANLEY ENGINEERING COMPANY
Consulting Engineers
Water Works—Sewerage
Electric Power—Flood Control
Rate Studies—Valuations—Industrial
Airports . . . . . Municipal Buildings
Hershey Bldg., Muscatine, Ia.

WESTON, ECKENFELDER and HOOD, INC.
Consultants
Engineers—Biologists—Chemists
Stream Pollution, Industrial Waste Disposal, Waste Utilization, Water Supply, Toxicity Evaluations, Laboratory Analyses, Surveys, Reports, Research and Development, Process Engineer, Plans and Specifications, Operation Control.
45 North Broad Street Ridgewood, N. J.

MR. CONSULTING ENGINEER
Are you interested in both
WATER & SEWAGE
If so there is no better place for your professional card than in this dual interest magazine.
WATER & SEWAGE WORKS

INDEX TO ADVERTISERS

A
Amercoat Corporation 87A
American Car & Foundry Co. 10A
American Concrete Pipe Ass'n 125A
American Concrete Pressure Pipe Ass'n. 127A
American Locomotive Company 123A
*Anthracite Equipment Co. 126A
Aurora Pump Company 91A

B
Badger Meter Mfg. Co. 20A-21A
B-I-F Industries 16A-17A
Bucyrus-Erie Company 8A
Builders-Providence, Inc. 16A-17A

C
Calgon Inc. 32A
Carborundum Co. 93A
Carson Co., H. Y. 118A
Cast Iron Pipe Research Ass'n. 18A-19A
Cement Gun Company 116A
Centriline Corp. 98A
Chain Belt Company 24A
Chapman Valve Mfg. Co. ..... 2nd Cover
*Chicago Bridge & Iron Co. 29A
*Chicago Pump Company 85A
Clow & Sons, James B. 103A
Combustion Engineering, Inc. 89A
Crane Company 99A

D
Darley & Co., W. S. 118A
Darling Valve & Mfg. Co. 109A
Detectron Corp. 91A
Dorr Company ..... 3rd Cover
Dresser Mfg. Division 101A

E
Electro Rust-Proofing Corp. (N.J.) 92A

F
Flexible Sales Corp. 124A
Foxboro Company 97A

*Advertisers with * were represented in the May 1953 Convention and Data Edition with Catalog specifications copy. Please refer to that issue for additional information on behalf of their products.

G
General Electric Company 14A-15A
Gruendler Crusher & Pulverizer Co. 114A

H
Hagan Corp. 32A
Hamilton-Kent Mfg. Co. 22A
Hardinge Company, Inc. 104A
Healy-Ruff Company 120A
Hersey Manufacturing Company 24A
Homestead Valve Mfg. Co. 112A
Hydraulic Development Corp. 122A

I
Iowa Valve Mfg. Co. 103A

J
Jeffrey Mfg. Co., The 28A
*Johns-Manville 121A
Johnston Pump Company 113A

K
Koppers Company, Inc. 115A

L
Layne & Bowler, Inc. 90A
Leopold Co., Inc., F. B. 114A
Le Roi Company 22A
Link-Belt Company 25A

Mc
McWane Cast Iron Pipe Co. 126A

M
*M & H Valve & Fittings Co. 100A
Minneapolis-Honeywell Reg. Co. 12A
Mueller Company 27A

N
National Clay Pipe Mfg. Co., Inc. 9A
National Supply Company, The 6A
Neptune Meter Company 34A
Norton Company 119A

O
Oliver Corporation, The 13A
Omega Machine Co. 16A-17A

P
Pacific Flush Tank Co. 33A
Pacific States Cast Iron Pipe Co. 126A
Payne Dean & Co. 124A
Peerless Pump Division 96A
Permutit Company 4A
*Philadelphia Quartz Company 116A
Phipps & Bird, Inc. 120A
Pipe Linings, Inc. 11A
Pittsburgh Coke & Chemical Co. 31A
*Pittsburgh-Des Moines Steel Co. 117A
Pollard Co., Joseph G. 96A
Precision Machine Co. 96A
Price Bros. Company 3A

R
Reliance Chemicals Corp. 118A
Rensselaer Valve Co. 30A
Roberts Filter Mfg. Co. 118A
Roots-Connersville Blower Division 106A
Royer Foundry & Machine Co. 104A

S
*Simplex Valve & Meter Co. 110A
Skinner Co., M. B. 114A
Smith Mfg. Co., A. P. 105A
Smith Co., S. Morgan 107A
Smith & Loveless, Inc. 122A
Spealman Elevated Tank Service 126A
Standard Dry Wall Products Co. 108A
Stuart Corporation 94A-95A

T
Taylor & Co., W. A. 120A
Tennessee Corp. 86A-126A

U
*U. S. Pipe & Foundry Co. 7A

V
Virginia Erection Co. 118A

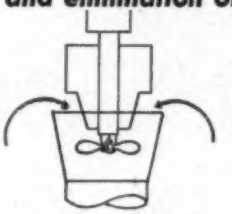
W
*Wallace & Tiernan Co., Inc. ..... Back Cover
*Walsbach Corp., The 88A
*Wilkinson Products Co. 120A
Wood & Co., R. D. 102A
Worthington Corporation 111A

In Sludge Digestion... you need all 4!

Effective, two-stage, sewage sludge digestion involves far more than just a heated tank! There are four major — and interrelated — requirements.

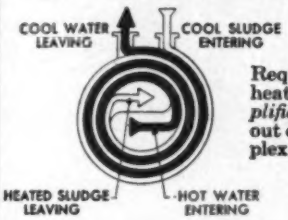
Here they are . . . and here's what you need to meet them . . .

1. Homogeneous mixing and elimination of scum



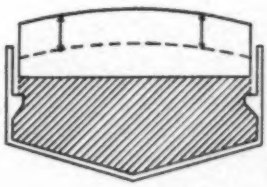
Calls for intensive mixing in the Primary by means of high-capacity propeller and draft tube.

2. Simplified Sludge Heating



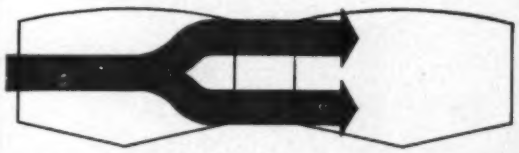
Requires an efficient heat exchanger of *simplified* design . . . without excessive and complex instrumentation.

3. Adequate Gas Storage



Demands a Secondary equipped with a movable, steel dome gas holder to even out fluctuations and insure a constant supply to gas utilization equipment.

4. Simplified Control



Requires a simple and automatic means of transferring sludge and liquor from the Primary to the Secondary at rate of feed.

Most important of all . . . you need a balanced and integrated System to meet these needs economically. Not an expensive conglomeration of unrelated units.

It will pay you to avoid the "piecemeal" approach. As proof, we suggest you compare the characteristics of Dorr Multdigestion* with any other digestion equipment.

*Reg. U.S. Pat. Off.

Better tools TODAY to meet tomorrow's demand

DORR

WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT

THE DORR COMPANY • ENGINEERS • STAMFORD, CONN.

Offices, Associated Companies or Representatives in principal cities of the world.

pedigree is no accident...

Just as a show-dog's winning pedigree is no accident, neither is the pedigree of a Wallace & Tiernan Chlorinator. Both are distinctive and reflect the result of years of selection, training and experience.

Selection, in the sense of progressive, laboratory-tested improvements in design and construction . . . Improvements which increase the value of dependability "inbred" in W&T Equipment for forty years.

Training, in the sense of a nation-wide staff of Chlorination Specialists, equipped to give prompt service and installation advice on all W&T Equipment.

Experience, in the sense of the many thousands of W&T Chlorinator installations, now meeting the particular daily chlorination requirements of communities all over the world.

The pedigree of a W&T Chlorinator is an open book. Why not write for a free introductory chapter today?

S-83

WALLACE & TIERNAN
NEWARK 1, NEW JERSEY